INSECTS OF MICRONESIA
Odonata*

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INTRODUCTION

The only previous attempt to bring together the published information on the dragonflies of Micronesia was made by Erich Schmidt (1938, Ent. Soc. Am., Ann. **31** : 322-344)[1] in his general analysis entitled "Check-list of Odonata of Oceania." This is a useful, though incomplete, paper in which only 10 regional species and subspecies are listed. A substantial addition to our knowledge was made by Syoziro Asahina with his well illustrated account of the anisopterous part of the results of Teiso Esaki's Micronesian Expeditions [1940, Tenthredo 3 (1) : 1-23]. This was followed by two other papers on regional dragonflies by the same author, one on *Hemicordulia* (1947, Mushi **17** : 79-87) and a special publication on the fauna of the Bonin Islands (1952, Mushi **23** : 45-56).

The United States Office of Naval Research, the Pacific Science Board (National Research Council), the National Science Foundation, and Bernice P. Bishop Museum have made this survey and publication of the results possible. Field research was aided by a contract between the Office of Naval Research, Department of the Navy, and the National Academy of Sciences, NR 106-175.

In agreement with the scope of this series, I have tried to include as much data on the immature stages as possible, and have made use of several unpublished drawings of new or known larval forms based on specimens collected outside of Micronesia. To facilitate comparisons, I have also characterized and illustrated an extra-limital subspecies of the common Micronesian coenagrionid *Agriocnemis femina* (Brauer), which was collected on the island of Okinawa.

The keys for the suborders and lower categories are designed to show some of the more constant characters. As far as the genera and immature stages are concerned, the keys apply primarily to the limited Micronesian fauna and are not necessarily adequate for identification of extra-regional species.

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* This represents, in part, Results of Professor T. Esaki's Micronesian Expeditions (1936-1940), No. 111.

[1] The style of bibliographic references has been changed to conform with the format of the Insects of Micronesia series.

The illustrations of wing venation are copied from enlarged photographs. All other illustrations are camera lucida drawings made by me, except for figures 1, 17, and 18, which are photographic reproductions of illustrations published by Dr. S. Asahina, who has generously given me permission to use them. The wing photograph shown in figure 16 is copied by permission from figure 340 in J. G. Needham and M. J. Westfall's "Dragonflies of North America"; and the photograph for figure 28 was made by the Leiden Museum photographer.

Unless otherwise indicated, the types of the new species and subspecies and, wherever available, the allotypes and one or more paratypes will be deposited in the United States National Museum (US); the prewar collections of the Japanese expeditions have been returned to Kyushu University (KU). Paratypes and other specimens will be distributed among Bishop Museum, California Academy of Sciences, Chicago Natural History Museum, Leiden Museum, and Museum of Comparative Zoölogy.

I am indebted to the many collectors who, often under difficult circumstances, have assembled the interesting lot of Micronesian Odonata reported upon in this account. Much information and help was given by the authorities of the museums which sent specimens on loan. I am also much obliged to Dr. Asahina for the loan of the Zygoptera from Kyushu University. In particular, my gratitude is expressed to J. Linsley Gressitt, who arranged and coordinated the distribution of specimens and to whom I owe the privilege and opportunity of studying this valuable material.

ZOOGEOGRAPHY

In this report 22 genera and 46 species and subspecies of the Micronesian odonate fauna are treated. They consist of 16 Zygoptera (damselflies) and 30 Anisoptera (dragonflies). I have examined all species of the Micronesian fauna except one, *Lestes boninensis* Asahina, and verified most published records. As I expected, a high percentage of the specimens is made up of widespread and common species, but the entire collection may be considered fairly representative. Roughly, two-thirds of the Odonata of Micronesia are listed in this report. Species yet to be discovered are probably inconspicuously colored forms of limited distribution or elusive species which, by some peculiarity of habit or habitat, tend to escape even the expert collectors.

There is only one endemic genus in Micronesia, the monotypic *Pacificothemis* of Ponape; and unless the zygopterid genus *Teinobasis* is split to sever the aberrant *T. carolinensis* (of Truk) from the rest, it is unlikely that more will be discovered.

The number of endemic species or subspecies in Micronesia is considerable: 12 (75 percent) of the Zygoptera and 13 (43 percent) of the Anisoptera. Endemism is most marked in Ponape (57 percent), the Bonins (45.5 percent),

Truk (33 percent), and Palau (22 percent). Next are the Marianas with three (21.4 percent) and Yap with only one endemic species (7.7 percent).

The origin of the Micronesian odonate fauna is complicated and not uniform. Leaving out all species of wide distribution, the character of the fauna is perhaps best expressed by the following brief discussion of the more interesting components in each group of islands.

Bonin Islands: Of the 11 species recorded, three genera and eight species are found nowhere else in Micronesia; five of these species are endemic and three are evidently incursions from the northwest. The fauna is alien to the rest of Micronesia. The occurrence of a red-bodied *Rhinocypha* (the only member of its family in Micronesia) is of interest; it shows remote affinities to Formosan and Philippine species of the genus. The origin of the other endemic forms is uncertain, but they probably came from the south.

Mariana Islands: The northern Marianas have been little collected, but they have an impoverished fauna. The southern group is interesting because of two anisopters not found elsewhere in the region: *Anax piraticus* (endemic) and *Hemicordulia mindana* (Philippine Islands). The three libellulids may be late additions to the fauna, as they belong to highly evolved genera and are subspecies which show a continuous distribution from India to the Pacific: *Agrionoptera insignis guamensis* and *Rhyothemis phyllis vitellina* (both probably of western origin, the latter known also from Palau and Yap), and the peculiar *R. regia chalcoptilon,* otherwise known only from Samoa. No Zygoptera of any interest are known from the Marianas, but it should be noted that the fauna of Guam is insufficiently known, only 12 species being recorded.

Palau Islands: The mixed character of this fauna is demonstrated by three endemic damselflies, which show affinities to Philippine or New Guinea forms, and three dragonflies, two of which are found in Yap. *Agrionoptera cardinalis* shows the effects of prolonged isolation in the marked differentiation from the parent stock, whereas the endemic *Teinobasis palauensis* evidently belongs to a Philippine species group.

Yap Island: Yap shares with Palau the precinctive Micronesian anisopter *Hemicordulia lulico,* and with the south Marianas and Palau, *Rhyothemis phyllis vitellina.* The endemic libellulid *Agrionoptera insignis yapensis* is allied to the Guam subspecies, *A. i. guamensis;* both are of western origin. No peculiar zygopters are known from Yap.

Truk Islands: Only six Odonata are reported from the Truk Islands. *Teinobasis carolinensis* is a highly interesting and aberrant zygopter, unlike anything known in this diversified genus; its life history is unknown. *Agrionoptera sanguinolenta pusilla* is also distinctive but suggests close relationship with *A. sanguinolenta* from Ponape, the nominotype of this new species. All are believed to be old residents, differentiated by long isolation.

Ponape Island: Besides the genus *Pacificothemis* and the species *Hemicordulia haluco* and *Agrionoptera sanguinolenta,* the percentage of endemics is exaggerated by the presence of no less than five precinctive species of *Teinobasis.* Probably all of these forest dwellers have arboreal habits; at least one species shows a marked preference for breeding in water accumulated at the leaf base of forest plants. The group is supposedly a local development from an ancestral immigrant species belonging to the *Teinobasis-Papuagrion* assemblage centered in New Guinea. Several of the latter are also known to have larvae that live hidden at the bases of the leaves of Pandanaceae. It is not unlikly that the entire group in Ponape is specialized to arboreal habits. Outside Micronesia, other highly specialized radiations of zygopterous Odonata in oceanic faunas occur in the Hawaiian Islands (*Megalagrion;* Zimmerman, 1948, Insects of Hawaii **1**: 342-381) and in Fiji (*Nesobasis;* Tillyard, 1924, Ent. Soc. London, Trans. **1923**: 305-335). In all these genera we find strikingly displayed the effects of insular evolution and speciation, presumably resulting partly from the absence of competition.

Kusaie Island: Here, again, one must rely on what appears to be only a small proportion of the Odonata actually inhabiting the island; all except the endemic *Hemicordulia erico* belong to forms common outside Micronesia.

Table 1.—Distributional List of Micronesian Odonata

	Micronesian Island Groups			Caroline								Particulars† and Other Localities		
	Bonin	N. Mariana	S. Mariana	Palau	Yap	Caroline A.	Truk	Ponape	Kusaie	Marshall	Gilbert			
Zygoptera														
Chlorocyphidae														
1. Rhinocypha ogasawarensis	×											E	W	
Lestidae														
2. Lestes boninensis	×											E	?	
Platystictidae														
3. Drepanosticta palauensis*				×								E	S	
Coenagrionidae														
4. Teinobasis palauensis*				×								E	W	
5. T. carolinensis*							×					E	S	
6. T. ponapensis*								×				E	S	
7. T. fortis*								×				E	S	
8. T. nigrolutea*								×				E	S	
9. T. ariel*								×				E	S	
10. T. aerides*								×				E	S	
11. Pseudagrion palauense*				×								E		
12. Ischnura aurora aurora			×		×	×	×	×	×	×	×	O		India, Ceylon, southeast Asia, Tuamotu and Marquesas Is., New Zealand
13. I. senegalensis	×											O	W	Old World tropics and temperate regions, East Africa to Japan, Ryukyus, Izu and Bonin Is., Moluccas
14. I. ezoin	×											E		
15. I. torresiana				×									S	North Australia, Torres Strait Is., New Guinea, Aru Is., New Hebrides, Banks I.

† E Endemic species or subspecies; a capital letter following E indicates the direction from which an ancestral form may have reached Micronesia.
O Forms of wide distribution throughout southeast Asia and, in many cases, beyond.
S Forms which have invaded Micronesia from the south (that is, the Papuan Region) or which appear to have their nearest relatives in the Melanesian area.
W Forms which seem to be spreading from the west (Malaysia, or the Philippine-Moluccan area) into Micronesia, or are most closely related to others inhabiting these regions.
N Forms regarded as invaders from the north within comparatively recent times, or which have their zoocenter in East Asia (Indo-Chinese immigrants).
* Described as new.

Table 1.—Distributional List of Micronesian Odonata (continued)

	Micronesian Island Groups											Particulars and Other Localities		
				Caroline										
	Bonin	N. Mariana	S. Mariana	Palau	Yap	Caroline A.	Truk	Ponape	Kusaie	Marshall	Gilbert			
16. Agriocnemis femina femina			×	×	×							O	W	India and Ceylon to Bismarcks and North Australia, Philippine Is., Moluccas
17. A. f. oryzae*														Ryukyus, Borodino Is., east China, Formosa, Hainan
Anisoptera														
Aeshnidae														
18. Anaciaeschna jaspidea			×	×	×							O		India to eastern Pacific
19. Anax parthenope julius	×												N	Ryukyus, Japan and China across southern central Asia to the Mediterranean and scatteredly northward to the Netherlands
20. A. guttatus			×	×		×		×	×	×	×	O	W	Seychelles to North Australia, Samoa, Tuamotu, Wake, Ryukyus
21. A. piraticus			×									E		
Corduliidae														
22. Hemicordulia mindana			×										W	Mindanao; ? Ryukyus; ? Formosa
23. H. ogasawarensis	×											E	S	
24. H. lulico				×	×							E		
25. H. haluco								×				E		
26. H. erico									×			E		
Libellulidae														
27. Pacificothemis esakii								×				E		
28. Lyriothemis insularis	×											E	S	
29. Agrionoptera insignis yapensis*					×							E	W	
30. A. i. guamensis*			×									E	W	
31. A. cardinalis*				×								E	S	
32. A. sanguinolenta*						×		×				E	S	

Table 1.—Distributional List of Micronesian Odonata (continued)

	Micronesian Island Groups													
				Caroline										
	Bonin	N. Mariana	S. Mariana	Palau	Yap	Caroline A.	Truk	Ponape	Kusaie	Marshall	Gilbert			Particulars and Other Localities
33. A. s. pusilla*							×					E	S	
34. Orthetrum sabina sabina						×						O	W	Egypt, through Asia to North Australia and Oceania; Ryukyus
35. Neurothemis terminata terminata				×	×	×							W	Malaysia; Lesser Sunda Is.; Philippine Is.
36. Diplacodes trivialis				×		×						O	W	Seychelles, India to Japan, Ryukyus; Australia and Fiji Is.
37. D. bipunctata	×	×	×	×	×	×	×	×	×	×	×	O	S	Moluccan Is. and eastward far into Pacific; chiefly insular. Ellice Is.: Funafuti
38. Zyxomma petiolatum				×								O	W	Mauritius; Seychelles; Laccadives; India and Ceylon across Indochina to the Ryukyus; through Malaysia to New Guinea and Queensland
39. Tholymis tillarga		×	×	×	×	×	×	×	×	×	×	O	W	Southern Asia to Australia and Oceania and to tropical Africa and Madagascar; on almost all island groups
40. Pantala flavescens	×	×	×	×	×	×		×	×	×	×	O	W	Tropics and warm temperate countries; almost cosmopolitan
41. Rhyothemis phyllis vitellina			×	×	×							E	W	
42. R. regia chalcoptilon		×	×											Samoa Is.; Wallis I.; Swains I.

Table 1.—Distributional List of Micronesian Odonata (continued)

	Micronesian Island Groups: Bonin	N. Mariana	S. Mariana	Caroline: Palau	Caroline: Yap	Caroline: Caroline A.	Caroline: Truk	Caroline: Ponape	Caroline: Kusaie	Marshall	Gilbert	Particulars and Other Localities		
43. Tramea virginia	×												N	Burma, Siam, southern Japan, Ryukyus; Billiton, Borneo
44. T. loewi					×								S	Australia; New Guinea; Lesser Sunda Is.; Moluccas
45. T. transmarina euryale	×		×	×	×								W	Malaysia; Celebes; Basilan; Mindanao; Northern and Southern Moluccas
46. T. t. propinqua							×	×	×	×	×		S	New Guinea; Misool; Aru Is.; Bismarcks; North Australia
47. Macrodiplax cora			×	×	×							O	W	Socotra, Seychelles, Mascarenes; India and southeast Asia to Samoa and Marquesas Is.
Total	11	4	14	18	13	9	7	14	6	6	6			

It is of little use to speculate on the origin of genera or species not mentioned above. Many of them are known to have migratory habits, others have a very wide range, and probably all are capable of covering great distances across the sea, either actively or passively.

The Micronesian Odonata show some negative characters which contrast with those of either the Oriental or the Papuan Region, or with both. These characters are: (1) absence of Amphipterygidae, Epallagidae, Calopterygidae (syn. Agrionidae), Megapodagrionidae, Protoneuridae, Platycnemididae, Gomphidae, and Cordulegasteridae; (2) poor development of Chlorocyphidae, Lestidae, and Platystictidae (each with only a single species); (3) absence of widespread species of *Ceriagrion, Archibasis, Argiocnemis, Aciagrion* and

thin, vertical, broadly dilated into paddle-like processes..............Coenagrionidae

5(1). Antenodal nervures of first and second series (that is, in costal and subcostal spaces) not all in alignment, except two primary ones, Ax_1 and Ax_2, which are strongly thickened; triangle of fore and hind wing not markedly dissimilar in shape, subequally distant from Arc and both elongate on long axis of wing; hind wing with clearly marked, though short and compact,

Xiphiagrion (Zygoptera), and *Potamarcha, Lathrecista, Brachydiplax, Raphismia, Nannophya, Crocothemis, Hydrobasileus, Camacinia, Urothemis,* and the nocturnal *Gynacantha* (Anisoptera); and (4) scarcity of the libellulids *Orthetrum sabina* and *Diplacodes trivialis,* two widely distributed species of common occurrence in cultivated areas of surrounding land masses. For a general survey of the fauna of these regions, see Lieftinck [1949, Nova Guinea, n. ser., **5**: 235-265 (New Guinea); 1954, Treubia **22**, Suppl.: 173-189 (Handlist of Malaysian Odonata)].

SYSTEMATICS

Key to Suborders and Families of Micronesian Odonata

1. Head transversely elongate, face and mouthparts protuberant; eyes hemispherical, prominent laterally and separated by a space greater than their own diameter. Fore and hind wings similar in outline and venation, with narrow or petiolate bases; anal field weakly developed or reduced; membranula absent; no differentiated discoidal field between M_4 and Cu_1, discoidal cell in form of a simple quadrilateral space (quadrangle), crossed or free. Male with two pairs of anal appendages, superior and inferior. Female with fully developed ovipositor. Wings, with few exceptions, in repose closed in a vertical plane above abdomen. Damselflies (suborder Zygoptera. *Larva* slender, usually with cylindrical abdomen not widening behind base; cercobranchiate, with two or three caudal appendages (gill lamellae) projecting from end of abdomen 2

Head compact, more or less globular, face and mouthparts not protuberant; eyes large and voluminous, never separated by a space greater than their own diameter and often meeting mid-dorsally. Fore and hind wings dissimilar in outline and venation, not petiolate, with anal field especially well developed in hind wing which is always broader than fore wing near base; membranula present; well-defined discoidal field present between M_4 and Cu_1, discoidal cell differentiated into triangle, hypertriangle, and (in fore wing) internal triangle. Male with paired superior anal appendages and only one inferior appendage dorsal to anal opening. Female with ovipositor complete or absent. Wings held horizontally or depressed in repose. Dragonflies proper (suborder Anisoptera). *Larva* stout, abdomen variable but always more or less widening behind base; proctobranchiate, without conspicuous caudal appendages or lamellae, anus surrounded by three stiff pointed valves (appendix dorsalis or epiproct, and inferior appendages or cerci), and a pair of lateral appendages (cercoids), which together form anal pyramid 5

2(1). Wings with 10 or more antenodal nervures; cross veins present in subquadrangle beyond Ac; Arc much nearer wing base than nodus; discoidal cell (quadrangle) long and narrow, reticulate; petiolation indistinct, narrow basal portion widening insensibly outward, with no marked angle between petiole and posterior margin at base of anal bridge; venation complex; apical portion of wing with numerous secondary sectors between main veins; pterostigma long and narrow (fig. 1, *b*). Abdomen shorter than hind wing. *Larva* compact, body rather depressed; antennal segment 1 almost as long as remaining ones combined; labium flat, lacking premental and palpal setae. Caudal lamellae represented by two long sharply triquetral

Head compact, more or less globular, face and mouthparts not protuberant.

lateral spines; middle gill rudimentary, represented by conical process surmounting subtriangular plate hardly longer than wide (fig. 2)........**Chlorocyphidae**

Wings with only two antenodal nervures; no cross veins in subquadrangle beyond Ac; Arc about midway between wing base and nodus; quadrangle variable in shape but uncrossed, its distal angle often acute; petiolation more marked, stalk almost parallel-sided; venation more open; apical portion of wing with secondary sectors between main veins, if present, shorter and fewer in number. Abdomen longer than hind wing. *Larva:* antennal segment 1 much shorter than others combined.. 3

3(2). M_3 and Rs (i.e., base of bridge to Rs) separating from upper sector of Arc, nearer Arc than nodus; an oblique cross vein present between M_2 and Rs situated about midway length of Rs; supplementary sectors (other than M_{1a}), running inward from distal portion of posterior margin in wing, at least present between Rs and M_3, and M_3 and M_4; M_{1a} usually zigzagged; distal angle of quadrangle sharply acute; pterostigma much longer than wide. Male superior anal appendages longer than segment 10, forcipate. *Larva* elongate and slender; proximal portion of labial prementum considerably narrowed, labial palpus greatly expanded distally, concave, its distal margin deeply cut by incisions, movable hook very large; setae present on prementum, palpus, and movable hook; caudal lamellae with main tracheae parallel, secondary tracheae arising at right angles to main stems................**Lestidae**

M_3 and Rs separating from upper sector of arculus nearer nodus than Arc or even arising beyond subnodus, close together, and occasionally almost fused at their origin; no supplementary sectors other than M_{1a}, which is straight or zigzagged; no oblique cross vein between M_2 and Rs; pterostigma short, often irregular in shape, but not markedly longer than wide.................................... 4

4(3). Quadrangle elongate, parallel-sided; accessory basal postcostal nervure present between Cu + A and A_1; Cu_1 reduced in length, falling well short of middle of wing; Cu_2 absent, hence no longitudinal vein (anal bridge) present between quadrangle and wing margin; Ab represented by a nerve descending from lower side of quadrangle to join Ac or wing margin; M_{1a} zigzagged. Wings falcate. *Larva:* labium flat, prementum large, more or less parallel-sided, its median lobe cleft apically; palpus relatively small, premental and palpal setae absent. Caudal lamellae inflated, in form of simple, elongate-oval sacs with long, slenderly pointed tips..**Platystictidae**

Quadrangle shorter, costal side always much shorter than anal; accessory basal postcostal nervure absent; Cu_1 and Cu_2 long, both extending distally beyond middle of wing, hence a well-developed longitudinal vein (anal bridge) present between quadrangle and wing margin; M_{1a} not zigzagged. *Larva*: labium flat, lateral margins of prementum diverging gradually from base, its median lobe entire apically; premental and palpal setae present; caudal lamellae thin, vertical, broadly dilated into paddle-like processes..............**Coenagrionidae**

5(1). Antenodal nervures of first and second series (that is, in costal and subcostal spaces) not all in alignment, except two primary ones, Ax_1 and Ax_2, which are strongly thickened; triangle of fore and hind wing not markedly dissimilar in shape, subequally distant from Arc and both elongate on long axis of wing; hind wing with clearly marked, though short and compact, anal loop, without midrib. Distal edges of labial palpi (lateral lobes of labium) not meeting in median line, median lobe large, exposed. Compound eyes meeting in middorsal line for appreciable distance. Abdominal segments with well-developed lateral carinae on 3 to 9 and transverse carinae on 2 to 8, dividing each segment into two sections. Anal appendages flattened dorsoventrally in both sexes. Female with well-developed ovipositor with styligerous genital valves. Insects of large size. *Larva* with elongate abdomen; labium flat, prementum much longer than broad at base, palpus narrow with long movable hook; no distinct premental or palpal setae................**Aeshnidae**

Antenodal nervures of first and second series continuous (few irregular exceptions), no easily recognizable primary antenodals; triangle of fore and hind wing dissimilar in shape, that of fore wing placed transversely far removed from arculus, that of hind wing elongate on long axis of the wing and close to level of Arc. Distal edges of labial palpi (lateral lobes of labium) meeting in median line, median lobe small, concealed. Anal appendages subcylindrical in both sexes. Female without ovipositor and genital valves reduced to single vulvar scale or pair of simple valvula, vulvae at apex of eighth sternite. Insects generally of smaller size. *Larva* stocky, abdomen not attenuated; labium broad, spoon-shaped, palpus strongly expanded apically with short movable hook; premental and palpal setae arranged in definite rows 6

6(5). Compound eyes with slight sinuous projection near middle of posterior edge. Body predominantly metallic green, pattern bicolorous or ill-defined. Abdomen slender, longer than hind wing. Triangle of fore wing not narrowed, costal side not much shorter than proximal side; second postnodal cross vein between M_1 and M_2 not more oblique than remainder; anal loop somewhat foot-shaped, but with little development of toe. First and third pair of male tibiae bordered inferiorly with narrow lamella (tibial keel). Anal border of male hind wing angulate with distinct once-traversed anal triangle (typical Corduliidae) or nearly rounded with secondarily reduced, weakly developed, non-reticulate anal triangle (*Hemicordulia*). Male with small auricula on each side of abdominal segment 2........ **Corduliidae**

Compound eyes not produced posteriorly near middle of border, margin at temples at most somewhat swollen (except *Macrodiplax,* in which it is slightly produced). Body not predominantly metallic green, pattern variable. Abdomen nearly always shorter than hind wing. Triangle of fore wing usually narrowed, costal side distinctly shorter than proximal side, or, if triangle is wider, then costal side more or less fractured; second postnodal cross vein (Px_2) between M_1 and M_2 (reverse vein) often oblique; anal loop variable, usually more angular and distinctly foot-shaped, with well-developed heel and toe. Tibial keels absent. Anal border of hind wing completely rounded in both sexes. No auriculae on sides of male abdominal segment 2........ **Libellulidae**

Suborder ZYGOPTERA

Family CHLOROCYPHIDAE

Genus **Rhinocypha** Rambur

Rhinocypha Rambur, 1842, Hist. Nat. Ins. Neuropt., 217, 232-233 (type: *Rhinocypha tincta* Rambur, op. cit., 237-238, male, Waigeu I.).

Labrum convex; clypeus swollen and upturned, projecting snout-like; anteclypeus and postclypeus both convex. Mesothoracic triangle not enlarged. Legs with long bristles; anterior tibiae with distinct comb. *Wings:* Sectors of Arc well separated at origin; Arc obtusely angled; M_{1-2} strongly anteriorly convex from upper sector of Arc (M_{1-3}); Ab and Cu_2 both well developed, Ab leaving wing border proximal to base of quadrangle and separated from border by single row of cells; M_4 and Cu_1 parallel, not zigzagged, with one row of cells between; at least two supplementary sectors between M_1 and M_2. Abdomen stout, rather depressed in male, thick and cylindrical in female.

DISTRIBUTION: Oriental, from Kashmir eastward to east China, Formosa, and the Bonin Is., and through Malaysia as far as the Solomon Is.

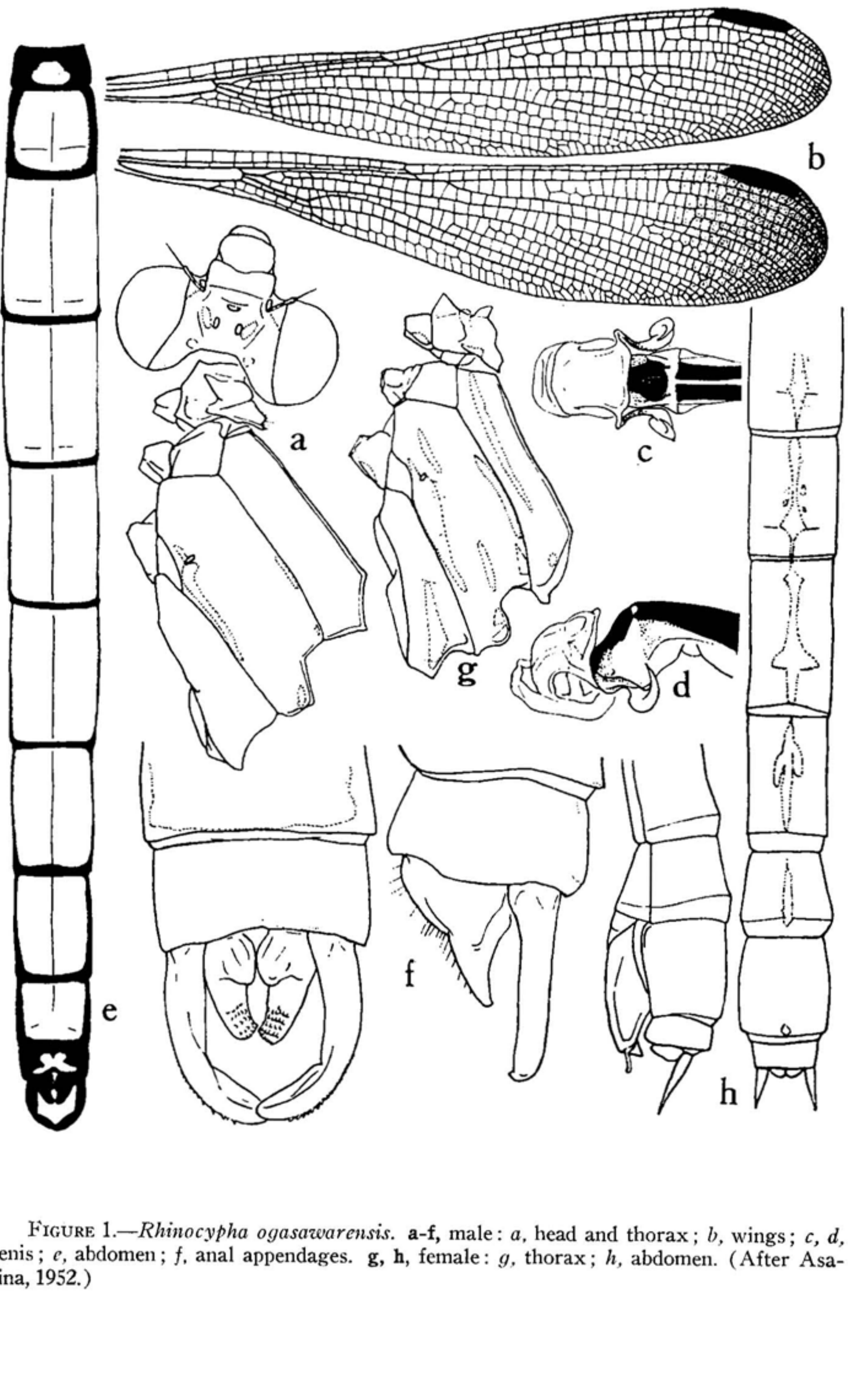


FIGURE 1.—*Rhinocypha ogasawarensis.* **a-f,** male: *a,* head and thorax; *b,* wings; *c, d,* penis; *e,* abdomen; *f,* anal appendages. **g, h,** female: *g,* thorax; *h,* abdomen. (After Asahina, 1952.)

1. **Rhinocypha ogasawarensis** Oguma (fig. 1).

Rhynocypha (sic) ogasawarensis Oguma, 1913, Zool. Mag., Tokyo **25**: 319 (Ogasawara); 1913, Tohoku Imp. Univ., Jour. Coll. Agric. **5**: 161 (Bonin).—Esaki, 1930, Biogeogr. Soc. Japan, Bull. **1**: 209 (list).

Rhinocypha ogasawarensis, Matsumura, 1913, Thousand Ins. Japan, Additamenta 1 (Tokyo): 48 (Chichi Jima).—Laidlaw, 1950, Roy. Ent. Soc. London, Trans. **101**: 271, 278.—Asahina, 1952, Mushi **23**: 48-49, 54, 56, pl. 7, figs. 7-16 (Chichi Jima, Haha Jima); 1956, Shin Konchū **12**: 52-53, fig. 17 (larval structures; Bonin Is.).

Head and thorax black, sparingly spotted and striped with yellowish; legs black. Wings (fig. 1, *b*) pale saffron, hind wing darkest and with apex from 3 to 4 cells proximal to pterostigma dark brown. Abdomen black, dorsum of segments (1)2-9(10) scarlet in male, yellowish to reddish brown with segments 1, 8, and 9 mainly black in female. *Male:* Abdomen 21.0 mm., hind wing 23.0-24.0 mm.; female: 17.0-19.0, and 22.5-25.5 mm., respectively. (Partly after Asahina.)

DISTRIBUTION: Bonin Is. (endemic).

BONIN IS. HAHA JIMA: Two females, July 1951, R. M. Bohart; female, Okimura, Apr.-May 1958, Snyder. ANI JIMA: Female, S. W. bay, May 1958, Snyder.

This species has no near allies but appears closely related to an undescribed red-bodied species from "Formosa" in the museum of the University of Michigan which presumably comes from the Ryukyu Islands where no *Rhinocypha* has yet been recorded.

Rhinocypha larvae are similar in general appearance, and specific differences in structure are slight. The Javan species *R. fenestrata* Burmeister is shown in figure 2.

FAMILY LESTIDAE

Genus **Lestes** Leach

Lestes Leach, 1815, IN Brewster's Edinb. Encyc. **9**(1): 137 (type: *Agrion barbara* Fabricius, 1798, Ent. Syst. Suppl., 286, male, Barbaria).—Fraser, 1951, Ent. News **62**: 69 (key).

This is a cosmopolitan genus with a great number of species forming a very heterogeneous assemblage.

2. **Lestes boninensis** (Asahina), n. comb.

Austrolestes boninensis Asahina, 1952, Mushi **23**: 49-51, figs. A-D, 54 (type, male, Chichi Jima); 1956, Shin Konchū **12**: 55-56 (Bonin Is.).

Male: Body yellowish, marked with metallic green dorsally. Head and thorax bronze green above; labrum, mandible bases, genae, and anteclypeus yellow, also pair of lateral stripes on prothorax, narrow humeral stripes abbreviated dorsally, and thoracic sides from first lateral suture downwards; legs yellow brown, inner faces and spines blackish brown. Wings hyaline; pterostigma narrow, parallel-sided, covering 3 cells; 13 to 14 postnodal

This species has no near allies but appears closely related to an undescribed

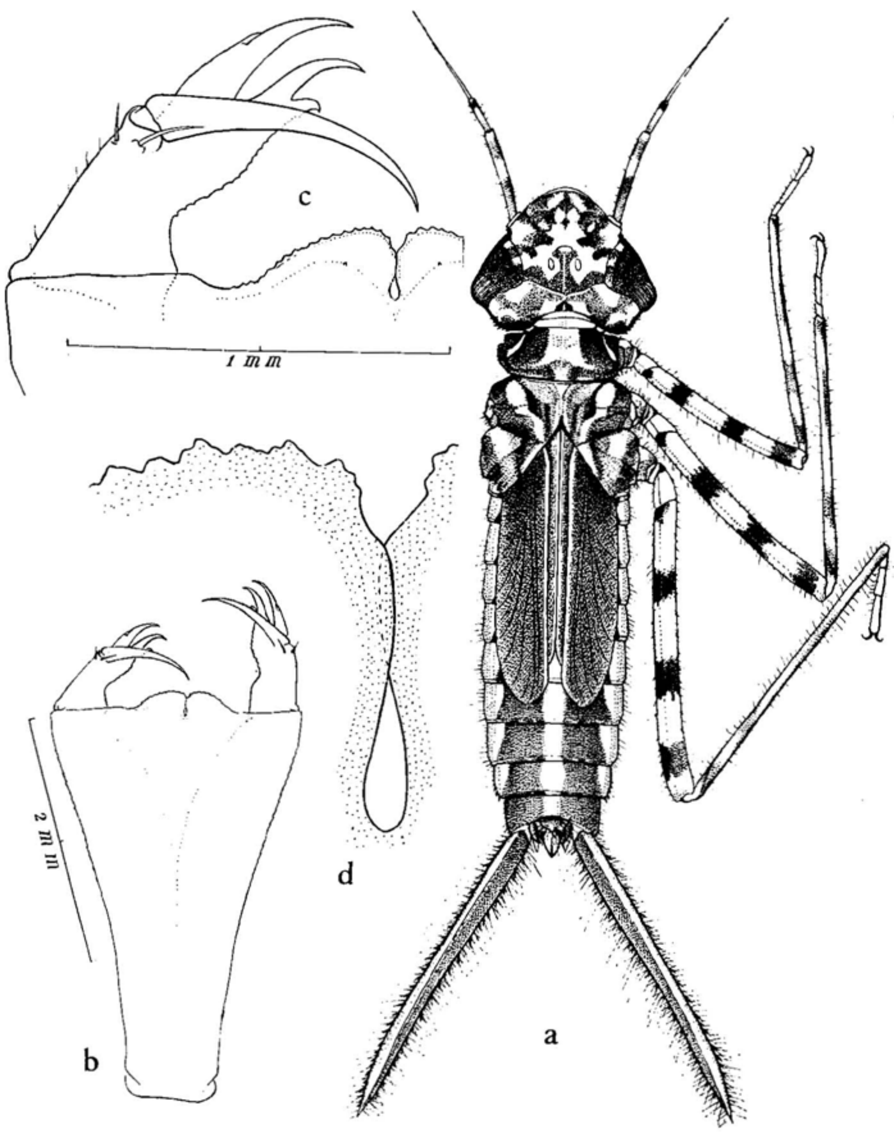


FIGURE 2.—*Rhinocypha fenestrata:* **a**, ultimate instar larva (live specimen), western Java (after Lieftinck, 1947); **b**, inner view of labium; **c**, **d**, left labial palpus and cleft median lobe of prementum, enlarged.

cross veins (Px) in fore wing, 11 to 12 in hind wing; quadrangle very narrow, dissimilar in fore and hind wing; costal side equal to proximal side and one-third of anal side in fore wing, twice as long as proximal side and one-half of anal side in hind wing. Abdomen with dorsum of segments 1 to 9 blackish brown, 1 and 2 somewhat tinged with green; sides of 9 apically, 10 except small middorsal basal streak, and anal appendages (except tips of superior pair) dull yellow. Superior appendages forcipate, gently incurved, inner margin with shelf-like projection ending in an acute tooth about two-thirds of whole length directed mesad, this tooth preceded by second, smaller projection before middle of whole length directed ventrad; inferior appendages about one-third length of superior pair, broad and approximated basally, then suddenly narrowed and diverging with upturned apices. Penis with internal lobe of segment 3 curled like a coil. *Abdomen:* 46.0 mm., hind wing 34.0 mm. (Description after Asahina, modified.)

I have not seen this species, but the unique type is well illustrated by Asahina. It is not an *Austrolestes,* but its allies are unknown. Pending a generic revision, the species is referred to *Lestes, s. lat.*

DISTRIBUTION: Bonin Is. (endemic).

For a discussion of various Indo-Australian species of *Lestes,* with notes on their relationships and illustrations of larval forms see Lieftinck (1960, Nova Guinea, Zool. **8**: 127-171).

FAMILY PLATYSTICTIDAE

Genus **Drepanosticta** Laidlaw

Drepanosticta Laidlaw, 1917, Indian Mus., Rec. **13**: 339, 341 (type: *Protosticta carmichaeli* Laidlaw, 1915, op. cit., **11**: 390, fig. 3, male, Sikkim).

This oriental genus (including *Ceylonosticta* Fraser) ranges from northeast India and Ceylon through southeast Asia as far east as New Guinea and adjacent small islands.

The larva of the Javanese *Drepanosticta sundana* (Krüger) was described by Lieftinck (1934, Treubia **14**: 463-468, fig. 1, pl. 9); it resembles that of *D. clavata* Lieftinck from New Guinea in almost every respect. Since the latter is related to *D. palauensis* described below, its larva should be easily recognized by comparing the sketches already published of *D. sundana* (fig. 11, *a, b*).

3. Drepanosticta palauensis Lieftinck, n. sp. (fig. 3).

Male: Labium brown; mandibles brown, upper half of exposed basal part cream; genae brown. Labrum and anteclypeus cream, anterior margin of labrum brown. Postclypeus and frons dark bronze, both very shiny; postclypeus transversely wrinkled, frons smooth and almost polished. Vertex and epicranium dull bronze black with slight greenish reflections; vertex on either side of ocellar triangle finely longitudinally striate. Occiput and rear of head deep black. Antennae, segment 1 brown tipped with pale yellow, segment 2 pale yellow tipped with brown. Parorbital ridge distinct, narrow; transverse postoccipital carina acute, lateral extremities prominent, acute angulate.

Prothorax brownish yellow, pleurae dark brown; pronotum forming low, evenly rounded partitions; margin of anterior lobe strongly raised, swollen and undulated; posterior lobe depressed, deeply excavated medially, incision broadly U-shaped, its lateral processes well-developed, divergent, forming prominent, outcurved, somewhat spoon-shaped lobes, entire posterior lobe more or less saddle-shaped.

Synthorax: mesepisternum, upper two-thirds of mesepimeron, metepisternum from spiracle upward, and dorsal one-fourth of metepimeron light brown; mid-dorsal carina finely, and center of ante-alar triangles as well as remaining parts of thoracic pleura brownish black or black, transition between light and dark colors not sharply defined; ventral surface of metepimera deep black, but medial poststernum as well as intersternum pale yellow.

Legs including coxae (except first coxa brown in basal half) pale yellow; apices of femora and tibiae finely ringed with brown and all femora with faint indication of pale-brown subapical bands; last tarsal segment also brown apically; spines and claws yellowish.

Wing membrane faintly tinged yellowish. Accessory basal postcostal nervure slightly distal to middle between wing base and Ax_1; Ac oblique, placed slightly nearer Ax_2 than Ax_1, meeting wing margin at prolongation of proximal side of q, joining Ab near margin

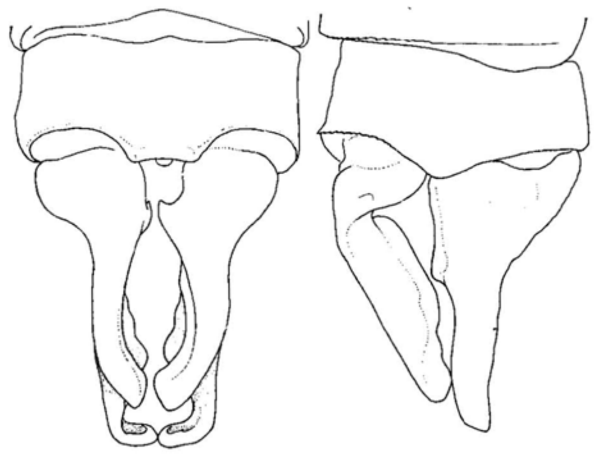


FIGURE 3.—*Drepanosticta palauensis*, anal appendages of male holotype, dorsal view and right side.

under an obtuse angle, thus forming short-stalked Y-vein; Ab only little longer than Ac. Cu_1 reaching hind margin at level of Px_4 in fore wing, of Px_6 in hind wing. Postnodals 14 to 15 in fore wing, 12 to 13 in hind wing. M_3 arises at subnodus, Rs half a cell beyond that level. Two postquadrangular antenodal cells. Pterostigma subrectangular, twice as long as broad, costal and anal sides parallel; proximal side slightly oblique, but distal side straight and rectangulate; color brown surrounded by fine yellow line.

Abdomen long and slender, terminal segments moderately expanded in both dimensions. Color uniformly brown, segmens 3 to 7 with narrow but sharply limited cream basal rings completely encircling segments; 8 to 10 brown, their posterior margins blackish. Anal appendages (fig. 3) dirty yellowish, as are also intersegmental membranes of segments 8 and 9 and 9 and 10.

Female: Differs from male only in following respects. Lateral processes of posterior lobe of prothorax longer, directed caudad, more or less finger-shaped, but depressed and gently outcurved, only a little shorter than median division of prothorax. Abdomen shorter, more robust, gradually expanded toward end; apical segments light brown, transverse carinae black. Eighth sternite and base of genital valves blackish. Segment 10 very short and annular. Anal appendages yellow, only a little longer than segment 10, triangular and pointed. Valves surpassing apex of appendages for about 0.2 mm.

Male: Abdomen 26.5 mm., hind wing 16.5 mm. (type); *female:* 24.0, 16.5 mm. (allotype); *female:* 24.0-25.0, 16.5-17.5 mm. (parallotypes).

Holotype, male, and allotype, female (in copulation, US 65135), jungle two miles northwest of Ngiwal, Babelthuap, Palau Is., May 21, 1957, Sabrosky. Paratypes (CM, KU, BISHOP): One pair, Ulimang, wooded valley, west, along shaded stream, Dec. 21, 1947, Dybas; two females, Emertao, Babelthuap, Feb. 1938, Esaki.

DISTRIBUTION: Western Caroline Is. (Palau).

The nearest relatives of this species are in New Guinea. It resembles most closely *Drepanosticta inconspicua* Lieftinck (Waigeu I.) and *D. clavata* Lieftinck (Humboldt Bay area) but differs from both in the structure of the prothorax and anal appendages of the male.

Family COENAGRIONIDAE

Key to Micronesian Genera of Coenagrionidae

1. Frons with prominent, or even acute, transverse ridge in front of ocelli; head transverse with large bulging eyes; no well-defined and conspicuously colored postocular spots. Body without sharply defined bright blue, green, or red markings. Wings comparatively narrow and generally not distinctly petiolated; Arc nearly always situated slightly or distinctly distal to level of Ax_2; position of nervures Ac and Ab very variable, both veins entering wing margin at a variable distance apart, though sometimes together, but Ab never proximal to level of Ac; M_3 and Rs close or completely fused at their origin, M_3 usually slightly curved basally and arising at or very near to subnodus, Rs at or a little beyond it; fore wing with 12 to 18 postnodal cross veins (Px). Tarsal claws simple or with small inferior subapical tooth. Male with sclerotized plate or tongue-shaped median process, variable in size and shape, arising from body wall below posterior margin of tenth abdominal tergite, situated between superior appendages; superior anal appendages biramous. Posterior lobe of female prothorax often modified, but without forwardly directed dorsal hooks or spines; apex of eighth abdominal sternite devoid of median spine. Very slender forms, abdomen at least 27 mm. long............**Teinobasis**

   Frons smoothly rounded without any indication of continuous transverse ridge in front of ocelli; head longer and more compact with eyes less protuberant; blue, green, or orange postocular spots often present. Body often partly bright blue, green, or red with bronze-black markings. Wings relatively broader and more distinctly petiolated; M_3 arising very distinctly before subnodus and curved basally, Rs at subnodus. Tarsal claws with distinct, inferior subapical tooth. Male without conspicuous process arising from body wall below posterior margin of tenth abdominal tergite, or with rudimentary tubercle only; superior anal appendages not biramous, but often spined interiorly or more or less bifid or branched at apex. Smaller and less slenderly built forms............2

2(1). Ab entering wing margin at point where Ac meets it; Ac situated at a level much nearer Ax_1 than Ax_2; Arc situated at level of Ax; fore wing with 13 to 14 Px; pterostigma of fore and hind wing similarly shaped and colored. Posterior lobe of female prothorax furnished with pair of small hooks or spines, directed forward and lying on dorsum of pronotum; apex of eighth abdominal sternite devoid of median spine. Body of male predominantly blue marked with bronze-black, female more greenish yellow with more extensive black abdominal markings. Larger species, abdomen 27 mm., hind wing 17 mm............**Pseudagrion**

wing margin at a variable distance apart, though sometimes together, but

Ab and Ac not together at wing margin, Ab entering margin well proximal to point where Ac meets it; Ac situated at level about midway between Ax_1 and Ax_2; position of Arc variable; fore wing with 6 to 10 Px. Posterior lobe of female prothorax lacking pair of forwardly directed horns or spines. Male with circular or pear-shaped postocular colored spots. Smaller species, female polychromatic 3

3(2). Arc usually situated at level of Ax_2, but occasionally slightly distal to it, its sectors arising well apart; quadrangle longer, its costal side in hind wing subequal in length to, or little longer than, proximal side, but barely as long as, or much shorter than, distal side. Size moderate to small, abdomen of male longer than 22 mm., or when shorter, color of abdomen predominantly red. Shape and color of pterostigma of male at least slightly dissimilar in fore and hind wing. Apex of tenth abdominal tergite of male more or less raised and produced posteriorly into pair of tubercles. Female with median spine at apex of eighth abdominal sternite.......... **Ischnura**

Arc situated well distal to level of Ax_2, its sectors arising close together; quadrangle short, its costal side in hind wing much longer than proximal side and also longer than distal side. Small species, with abdomen not exceeding 19 mm. in length; only 6 to 8 Px in fore wing. Pterostigma of fore and hind wing similar in shape and usually also in color. Apex of tenth abdominal tergite of male shallowly emarginate, lacking pair of raised tubercles. Female lacking median spine at apex of eighth abdominal sternite.......... **Agriocnemis**

Key to some Larvae of Micronesian Coenagrionidae

1. Head about two times wider than long and, after a short constriction behind eyes, abruptly expanded with prominently angulate postocular lobes. Labium relatively long, prementum strongly widened from hinge outward with sides slightly concave, its median lobe obtuse but strongly protuberant; only one premental seta on each side. Palpus with four setae; rather short and robust, apex deeply bifid with robust curved acuminate end hook followed laterad by almost equally long elongate process, obliquely truncated and bearing three to four cusps apically; movable hook strong, sickle-shaped (fig. 12). Caudal lamellae nodate about midway, with distinct nodal line; lanceolate, sides subparallel with bluntly rounded tips; dorsal margin of median lamella and ventral margin of lateral lamella with antenodal row of increasingly longer spinulose setae and ending in nodal spine; marginal setae on opposite sides of lamellae obsolete; branch tracheae with rich development of dendritic tracheoles toward margin (fig. 11, *c-e*; this definition applies only to the species group of *P. microcephalum*).......... **Pseudagrion**

Head not as broad, diminishing in width behind eyes, postocular lobes rounded with bulging hind angles, between which is a deep occipital excavation. Caudal lamellae denodate or subnodate, but node often indicated by transverse pigmented mark on gill axis.......... 2

2(1). Labium short and wide, sides of prementum slightly convex, its median lobe not prominent; only one premental seta on each side. Palpus with four setae; narrow, gradually tapered, apex bifid with short blunt end hook and strong movable hook; outer margin fringed with some longish hairs. Caudal lamellae broad, gradually expanded, widest at three-fourths their length and suddenly narrowed to obtusely pointed apex; antenodal part with usual short and longer rows of spinulose setae along opposed margins; branch tracheae numerous, long and fine, only feebly branched (fig. 9).......... **Teinobasis**

Labium longer, prementum regularly widened from hinge outward with straight borders, its median lobe more prominent; at least four premental setae on each side arranged in oblique rows. Palpus broader, expanded apically, with distal margin longer and dentate. Caudal lamellae narrower.................... 3

3(2). Small; abdomen plus caudal lamellae 8.0+4.5 mm. Caudal lamellae almost pedunculate, narrowly lanceolate, widest at middle, with apices sharply acuminate; apical portion with five transverse pigment bands (fig. 11, *f, g*). Labium with four premental setae on each side and five palpal setae............ ....**Agriocnemis femina**

Generally larger. Caudal lamellae broader, widest beyond middle with apices acuminate; no transverse pigment bands or with single transverse pigmented mark at level of node. Labium with four to six premental setae on each side and five to seven palpal setae..**Ischnura** spp.

Genus **Teinobasis** Kirby

Teinobasis Kirby, 1890, Syn. Cat. Neuropt. Odonata, 157 (*nom. nov. pro Telebasis* Selys, 1877).—Ris, 1915, Nova Guinea, Zool. **13** (2) : 100-105, figs. (group characters).—Cowley, 1934, Entomologist **67** : 253 [type: *Telebasis superba* Selys, 1877, Bull. Acad. Roy. Belgique **43** (2) : 112, 114-115; lectotype, male, Manado, North Celebes, Mus. Leiden]. Not *Telebasis* Selys, 1865.—Lieftinck, 1935, Nova Guinea, Zool. **17** : 234-269 (genotype redescribed and illustrated; partial revision of *Papuagrion* and *Teinobasis*; key, p. 237); 1949, op. cit., n. ser., **5** : 146-176, figs. (same genera, New Guinea species); 1957, Zool. Meded., Leiden **35** : 168-175, figs. (Philippine species).

This genus includes a large number of species in southeast Asia, more than 50 of which have already been described. Its range extends from the Malay Peninsula and the Philippine Islands southeastward through the Papuan region and North Queensland to the Solomon Islands. (The two described forms from the Seychelles and Madagascar are doubtfully congeneric.) At present, the Philippine Islands and New Guinea appear to be the principal centers of dispersal; comparatively few species have spread in the opposite direction beyond the limits of these great land masses. *Teinobasis* is even less homogeneous than, for instance, *Pseudagrion*; but at present it is impossible to attempt a complete review of the many species groups within this large genus. It is divisable into at least three sections, but none of them appear to represent a natural cleavage and, unfortunately, many species are intermediate in one way or another.

The Micronesian species also clearly fall into different groups, but for purposes of identification it is most satisfactory to keep them united and combine them in one key. They have several characters in common, but the great diversity in venation and general appearance shows that they are not all closely related. This variety, I believe, is sufficiently indicated in the generic diagnosis given above and in the key to the species: it finds expression also in the illus-

Telebasis Selys, 1865.—Lieftinck, 1935, Nova Guinea, Zool. 17 : 234-269

tration of the wings and genital structures. Pending a revision of the whole complex, I can do no better than to present full descriptions of the regional species, with notes on their affinity. To facilitate comparisons, I have added some drawings of the labium (fig. 10, *d*) and wings (fig. 4, *a, b*) of the genotype, *Teinobasis superba* (Selys) from Celebes, a species redescribed elsewhere (Lieftinck, 1935).

So far as known, all species are forest dwellers which avoid cultivated areas. The larvae live either in small, slowly moving streams or in water accumulated in the axils of *Pandanus* and *Freycinetia* (Gressitt, 1954, Insects of Micronesia **1**: 159-163, fig. 24), agreeing in this respect with the allied genera *Papuagrion, Amphicnemis,* and *Pericnemis*. I include here a brief description and an illustration (fig. 9) of a larval type from Ponape. *Teinobasis* larvae differ greatly in structure, but they are too little known to admit any correlation with the morphology and ethology of the adult dragonfly.

KEY TO MICRONESIAN SPECIES OF TEINOBASIS (MALES)

1. Nervure Ac situated much nearer Ax_1 than Ax_2. Ab entering wing margin far distant from Ac, about midway length of quadrilateral. Basal fragment of M_3 and Rs completely fused, arising from common curved stalk distal to subnodus. Costal side of quadrilateral in fore wing subequal in length to proximal side or longer, occasionally as long as distal side. Wings (fig. 5, *a*) not distinctly petiolated, membrane relatively broad beyond middle, tips rather pointed, pterostigma very small. Arculus distal to Ax_2; three postquadrangular antenodal cells; 12 (13) postnodals of first series in fore wing, 11 in hind wing; no divided cells between C and R_1 distal to pterostigma. Rear of head pale-colored. Thorax relatively short and small. Femoral spines 3-4-4 in outer row, all shorter than interspaces; tarsal claws lacking an inferior tooth. Upper branch of superior anal appendage broad, much shorter than lower, latter longer than inferior pair (fig. 4, *c-e*). Palau..**4. palauensis**

   Nervure Ac situated nearer Ax_2 than Ax_1. Ab entering wing margin near level of proximal side of quadrilateral in close proximity to Ac, or together. M_3 and Rs well separated basally, point of their origin variable, M_3 generally arising before or at subnodus, its basal fragment more or less curved, Rs at or a little beyond subnodus and with its basal fragment straight, both veins often very closely approximated at origin, but never fused. Costal side of quadrilateral in fore wing shorter than or subequal in length to proximal side, considerably shorter than distal side. Wings usually more plainly petiolated; three postquadrangular antenodal cells. Rear of head mostly black.. 2

2(1). Body conspicuously bright orange chrome marked with metallic blue, green, or black. Frontal ridge not acute. Thorax relatively short and high. Wings relatively narrow with pointed tips; neuration open; 12 to 14 postnodals of first series in fore wing; only one row of cells between C and R_1 distal to pterostigma. Inferior dorsoapical process of segment 10 subquadrangular, almost vertical, apex slightly emarginate. Upper branch of superior anal appendage incurved, only little longer than lower branch, both slightly longer than inferior pair (fig. 8, *e-g*). Ponape..**8. nigrolutea**

   Combined characters not as above.. 3

3(2). At least some divided cells between C and R_1 distal to pterostigma and at least 17 postnodal cross veins of first series in fore wing; wings rather abruptly petiolated with relatively long and pointed tips; neuration close; pterostigma very oblique, not black. Thorax short and stout. Body and legs predominantly black, partly coarsely pruinescent. Posterior femur with four spines in outer row. Inferior dorsoapical process of segment 10 deeply emarginate, its branches produced to form a pair of strongly recurved hooks. Upper branch of superior anal appendage much longer than lower branch, latter about as long as inferior pair (fig. 7, *d-f*). Robust species. Ponape .... **7. fortis**

No divided cells between C and R_1 distal to pterostigma (rarely one or two forked cells in one of wings) and with fewer postnodal cross veins in fore wing. Remaining characters not as above 4

4(3). Femora heavily striped with black exteriorly and with 3-4-5 spines in outer row shorter than interspaces. Labrum and postclypeus glossy black. Body predominantly black, thorax partly coarsely pruinescent. Wings narrower, less plainly petiolated, with apices less drawn out, and with the black pterostigma smaller and less oblique than in *fortis*. Thorax relatively long and slender. Neuration open, 13 to 14 postnodal cross veins of first series in fore wing. Inferior dorsoapical process of segment 10 in caudal view much broader than long, distal margin emarginate with produced lateral angles. Lower branch of superior appendages only one-third length of upper branch and about two-thirds length of inferior pair (fig. 7, *a-c*). Ponape .... **6. ponapensis**

Femora not striped with black exteriorly, but if with a brown stripe then posterior femur with seven spines in outer row. Labrum and postclypeus usually pale-colored, not wholly deep black. At least thoracic sides and head with much pale coloring. Inferior dorsoapical process of segment 10 and anal appendages not shaped as above 5

5(4). Posterodorsal margin of segment 10 greatly swollen, bituberculate; inferior dorsoapical process more deeply recessed and produced apically into knob-like median tubercle. Anal appendages much shorter than segment 10, both pairs of equal length, upper branch of superior appendage with down-curved subapical interior tooth, apex of inferior appendage broad, more or less saucer-shaped (fig. 6, *d-f*). Habitus and color-pattern as in figure 6, *a, b*. Posterior lobe of prothorax suberect, strongly projecting medially. Femora striped with brown exteriorly; 3-6-7 spines in outer row. Wings with tips bluntly rounded (fig. 5, *b*). Truk .... **5. carolinensis**

Characters not as above. Inferior dorsoapical process of segment 10 vertical, subtriangular in outline, apex bluntly pointed. Anal appendages shaped as in figures 8, *a-c*; 10, *a-c* 6

6(5). Juxtahumeral (mesepimeral) pale stripe widest above, tapering gradually downward from upper end of humeral suture for at least two-thirds length of mesepimerum. Labrum dark brown or black. Ground color of body yellowish brown. Head relatively smaller, eyes less prominent, width across eyes 3.7-3.8 mm. Neuration closer; 13 to 16 Px of first series in fore wing; pterostigma black. Size variable, but abdomen not exceeding 34 mm. Ponape .... **9. ariel**

Juxtahumeral (mesepimeral) pale stripe short, tapered on both ends, not reaching upper end of humeral suture and extending barely halfway down mesepimerum. Labrum pale-colored. Ground color of body flavous. Head larger, eyes very bulging, width across eyes 4.0 mm. Neuration open; only 12 Px of first series in fore wing; pterostigma brownish yellow. Abdomen very long, 38.5 mm., hind wing 22.0 mm. Ponape .... **10. aerides**

5(4). Posterodorsal margin of segment 10 greatly swollen, bituberculate; inferior

4. Teinobasis palauensis Lieftinck, n. sp. (figs. 4, *c-e*; 5, *a*).

Male: Labium pale yellow to light ochreous; mandible bases deep black surrounded by yellow; genae to beyond level of antennae, and anteclypeus at middle and laterally light blue or faded to olivaceous. Labrum and postclypeus blackish brown or black, rather shiny, labrum finely ochreous along anterior border. Anterior surface of frons and antennal sockets in front blue green. Frons almost rectangulate, transverse ridge broad, well developed, obtuse. Head otherwise unicolored dull metallic greenish black, but rear greenish yellow. Antennae pale brown, first two segments obscured anteriorly.

Posterior lobe of prothorax very short, margin somewhat raised, evenly rounded, with very shallow median emargination. Dorsum of pro- and synthorax either metallic black or dark brown changing to rust color toward humeral suture, beyond that level light blue, often discolored to dark olivaceous and fading to greenish yellow laterally and underneath; metepimerum, infraepisternites, and coxae pruinescent gray blue.

Legs pale greenish yellow, femora slightly obscured exteriorly and at apices, outer faces of tibiae with ferruginous line and tarsi pale ochreous; tarsal claws simple, lacking inferior tooth. Femoral spines 3-4-4, all a little shorter than interspaces.

Wings clear, shape and neuration as shown in fig. 5, *a*; Px of first series 12 (rarely 13) in fore wing, 11 in hind wing; pterostigma small and slightly oblique, blackish brown surrounded by a fine yellow line.

Abdomen long and slender, terminal segments slightly expanded. Segments 1 and 2 bronze black above changing to blue green laterally, dorsal mark of segment 2 ill-defined, rather constricted at middle; dorsum of 3 to 7 dark bronze black, sides yellow brown, each segment carrying pair of small blue-green dorsolateral spots, dark bands of dorsum progressively wider distad and, after a slight subterminal constriction, expanded to form black apical rings about three times length of pale basal spots; 8 to 10 and appendages dull bronze black, only intersegmental rings narrowly pale colored. Posterior border of segment 10 and anal appendages as in figure 4, *c-e*.

Abdomen 32.0 mm., hind wing 19.5 mm. (type); 30.5-34.5, 19.0-20.0 mm. (paratypes, Koror); 30.5, 19.0 mm. (Babelthuap).

Female: Unknown.

Some variation exists in the position of nervure Ac, which in one male from Koror is situated almost precisely at level of Ax_1. Also, the length of the quadrilateral varies, but in most specimens the costal and distal sides of the fore wing are equally long.

Holotype, male (US 65136), Koror I., Palau Is., Mar. 15-24, 1948, no. 485531, Maehler. Paratypes (US, CM, BISHOP): Male, Koror, Apr.-May 1949, Langford; male, Koror, May 1957, Sabrosky; male, Babelthuap I., Ulimang, "wooded valley W., along shaded stream," Dec. 1947, Dybas.

DISTRIBUTION: Western Caroline Is. (Palau).

This species falls in Ris' section I. B, which comprises a fairly well-defined group of pale-colored species centered in the Philippine Islands. The members of this group agree with the genotype *superba* in the distal position and basal approximation or fusion of the veins M_3 and Rs, but they differ in Ac, being placed much nearer to Ax_1 than to Ax_2 (figs. 4, *a, b*; 5, *a*). *Teinobasis palauensis* is easily recognized by the combined characters of venation and male anal appendages (fig. 4, *c-e*). It comes nearest to *recurva* (Selys) from Mindanao and *olivacea* Ris from Mindoro; and with them, it forms a natural group.

Female: Unknown

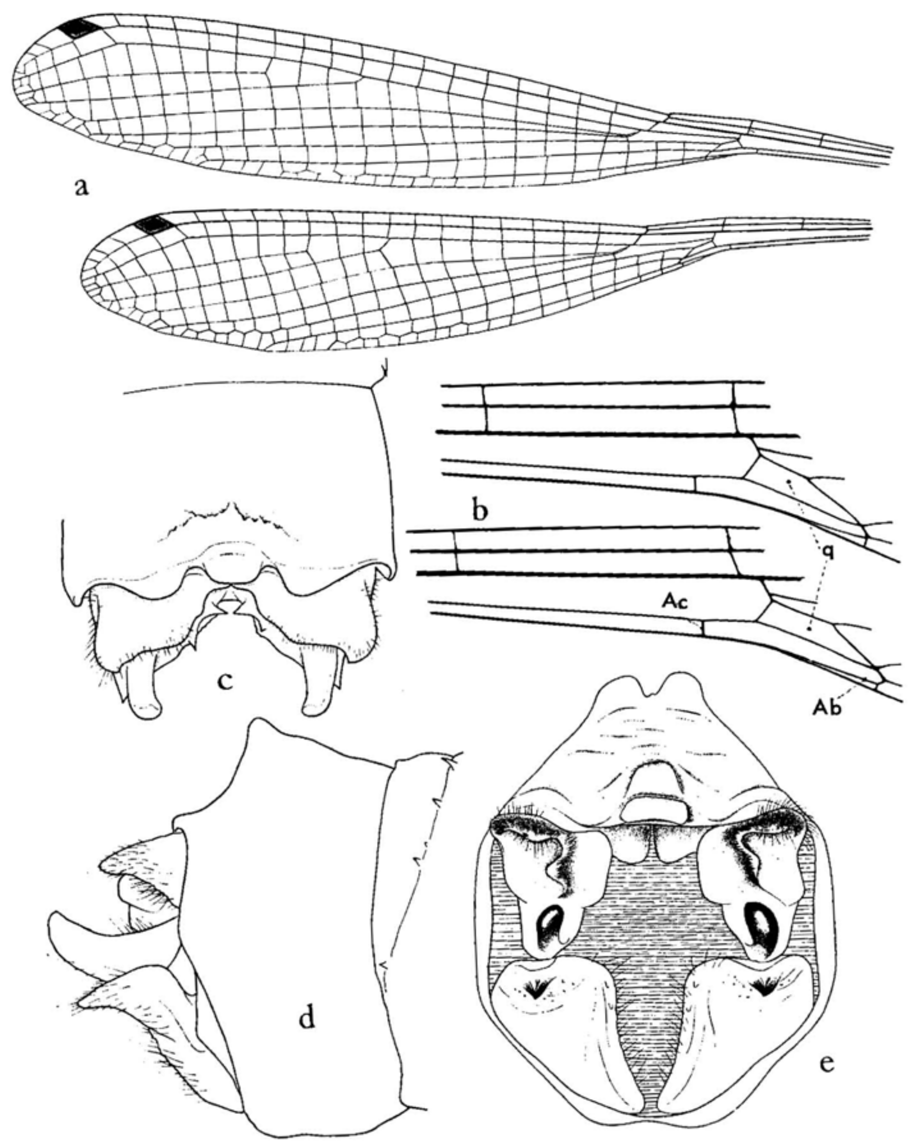


FIGURE 4.—**a, b,** *Teinobasis superba*, north Celebes: *a*, male wings; *b*, basal portion of fore and hind wings, enlarged. **c-e,** *T. palauensis*, anal appendages of male holotype, *c*, dorsal view; *d*, right side; *e*, caudal view. Abbreviations: q = quadrangle; Ac = anal cross vein; Ab = anal bridge.

5. Teinobasis carolinensis Lieftinck, n. sp. (figs. 5, *b*; 6; 10, *e*).

Male: Labium (fig. 10, *e*) pale yellow; genae, along eye margin as far as base of antenna, and mandibles greenish yellow, the latter with central patch of cloudy brown. Labrum and clypeus dark brown, rather shiny, labrum finely bordered with dull yellow and with three distinct pale spots at extreme base; lateral edges of anteclypeus and fine line at frontoclypeal sulcus also yellowish. Frons almost rectangulate, transverse ridge short and straight, subacute. Head otherwise dark bronze brown, almost black; epicranium dull, with oblique yellowish streak each side between lateral ocellus and antennal base and a similarly colored stripe along occipital margin; ventral surface of genae on each side of labium greenish yellow. Antenna with segment 1 brown, its apical third pale yellow, segment 2 dark brown tipped with reddish.

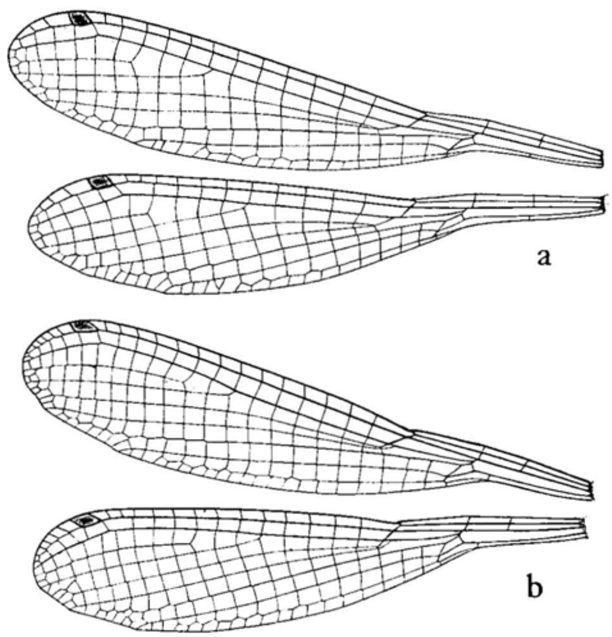


FIGURE 5.—Male wings: **a**, *Teinobasis palauensis;* **b**, *T. carolinensis.*

Posterior lobe of prothorax markedly protuberant in middle, its surface convex, median division much longer than lateral lobes, directed obliquely upward, shallowly emarginate, but lobes thus formed approximated and almost semicircular, their surface concave anteriorly, thickened margin fringed with pale pubescence; lateral lobes evenly rounded. Ground color of pro- and synthorax yellow brown marked with dull bronze brown, but somewhat more extensively than shown in a semiadult male (fig. 6, *b*), in which the ground color is paler and occupies more of the surface. Rear of head, prothorax laterally, most of thoracic sides and undersurface and coxae on outer face coarsely pruinescent gray blue.

Legs pale ochreous, femora striped with brown exteriorly, knees more extensively brown; outer face of tibiae and tarsi likewise brown, claws reddish; tarsal claws with minute blunt subapical inferior tooth. Femoral spines brown, 3 (rarely 4)-6-7 in outer row, slightly increasing in length from base to apex, distal ones distinctly longer than interspaces.

Wings (fig. 5, *b*) rather broad and abruptly petiolated; apices obtusely rounded; membrane uniformly tinged dirty yellowish; Ab and Ac meeting wing margin coincidently or Ab a trifle distal to Ac; costal and proximal sides of q in fore wing of equal length and about two-thirds length of distal side, in hind wing costal side much longer, subequal to or little longer than distal side; Arc at Ax_2; M_3 and Rs usually well separated at origin, M_3 arising a little before, Rs at subnodus. (In the type base of M_3 less convex and more approximated to Rs than in wing photograph, fig. 5, *b*, of a paratype.) Only one row of cells between C and R_1 distal to pterostigma, rarely one or two cells forked toward costal margin. Pterostigma moderately oblique, lozenge-shaped, but a little longer than high, proximal side slightly more oblique than distal; color yellowish centered with dark brown. Postnodal cross veins of first series 14-16 in fore wing, 13-15 in hind wing.

Abdomen slender, apical segments from base of 7 onward gradually expanded, apex truncated; ground color warm buff marked with ochraceous tawny deepening to cinnamon brown mid-dorsally; apical segments laterally, intersegmental membrane, and elevated apical rim of segment 10 again rather paler; 10 and appendages shaped as in figure 6, *d-f*.

Female: Resembles the male in most respects but body coloring generally lighter, lacking pruinescence; dark markings more restricted, especially on anterior part of head and thoracic pleurae (fig. 6, *a*, *b*). Labrum and clypeus ochraceous tawny, labrum with anterior border yellowish, basolateral margin brown; anterior surface of frons also pale colored. Prothorax with basal margin of posterior lobe short and broad, somewhat elevated and swollen, closely apposed to median lobes of pronotum; remainder of posterior lobe shorter than in male, its median division little longer than lateral parts and only shallowly emarginate, forming broadly rounded lobes. Mesostigmal plates triangular in outline. Basal yellow annules on abdominal segments 2 to 8 more pronounced and larger, terminal segments and appendages as in figure 6, *g*. Genital valves markedly surpassing apex of abdomen, color light brownish yellow; appendages very short, bluntly conical.

Male: Abdomen 35.0, hind wing 21.0 mm. (type); *female:* 31.0, 20.0 mm. (allotype); *male:* 30.5-35.0, 18.0-21.0 mm., *female:* 31.5-32.0, 20.5-21.0 mm. (paratypes).

Holotype, male (US 65137), Wena (Moen) I., Nantaku area (Mts. Chukumong and Tonaachau), Truk, Mar. 21, 1949, Langford; allotype, female (US) same locality as holotype, Mar. 25, 1949, Langford. Paratypes (US, BISHOP): Several of both sexes, same locality as for types, Jan.-Apr. 1949, Langford; male, Mt. Chukumong (Teroken), slope to docks, sea level to 78 m., Feb. 1953, Gressitt; two males, Fefan I., Nov. 1937, Sakae Tanita, and Tonoas I., Erin, Apr. 1940, Yasumatsu and Yoshimura (KU); female, Ton (Tol) I., lower slope of Mt. Unibot, Dec. 1952, Gressitt.

DISTRIBUTION: Eastern Caroline Is. (Truk).

This remarkable species has no near allies, as it occupies an isolated position in the Truk group, where it is apparently widespread and abundant on forest streams. Superficially it resembles some members of the Papuan platycnemidid genus *Idiocnemis*, especially in the rather wide head, long tibial bristles, broad and regularly veined wings, and scheme of coloration. Some of these features may be considered primitive. The entire insect and the penile organ of the male are shown in figure 6; these may prove useful for a future revision of the genus.

6. **Teinobasis ponapensis** Lieftinck, n. sp. (fig. 7, *a-c*).

Male (holotype): Labium pale ochreous; mandibles creamy yellow, basal portion with central area deep black. Anteclypeus and genae upward almost to level of antennae creamy yellow. Labrum and postclypeus deep shiny black, labrum bordered anteriorly with pale

domen, color light brownish yellow; appendages very short, bluntly conical.

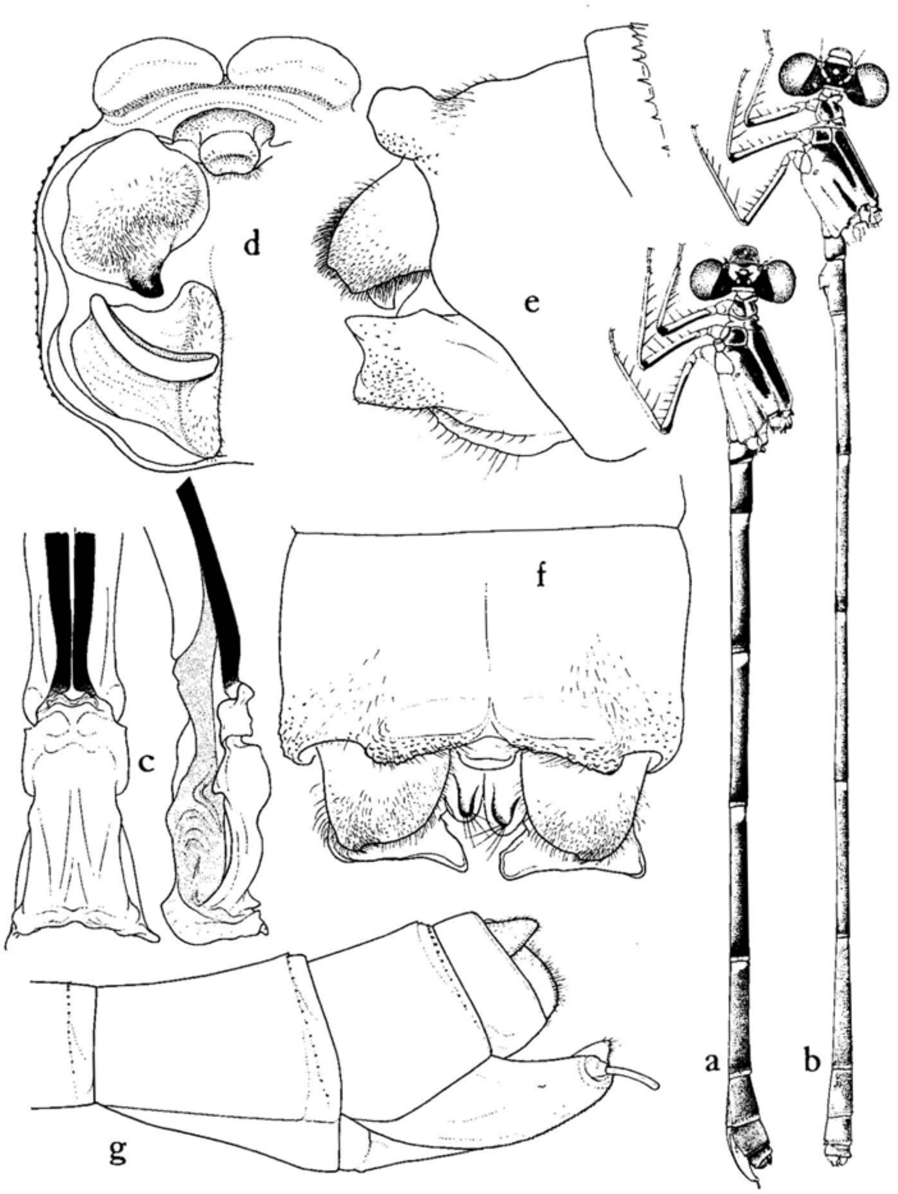


FIGURE 6.—*Teinobasis carolinensis:* **a,** female; **b,** male; **c,** ventral view and right side of penis. **d-f,** anal appendages of male: *d,* partial caudal view; *e,* right side; *f,* dorsal view; **g,** apex of female abdomen, left side view.

ochreous. Frons almost rectangulate, transverse ridge subacute, slightly undulated; color dull metallic greenish black except an oblique ochreous line on either side in front. Head, including rear, otherwise unicolored greenish bronze black, only the ventral surface of genae, on each side of labium, light green. Antennae with segment 1 blackish except posteriorly, segment 2 brown, darkest in front, remainder dark brown.

Posterior lobe of prothorax depressed, somewhat projecting medially, but free margin evenly convex and side margins rounded. Prothorax entirely and synthorax almost as far down as metaspiracle and upward beyond that level as far as second suture unicolored dark bronze black; sides marked indistinctly over first suture with yellowish-brown stripe crossing spiracle and with most of metepimeron similarly colored, ventral edges of metinfraepisternum and dorsal ridges of metepimeron blackish; ventral surface of thorax pale ochreous, pruinescent blue.

Legs pale ochreous; femora conspicuously and heavily striped with black exteriorly, these stripes broadening toward apex, knees entirely black; basal half of tibiae obscurely brown outwardly and tipped with black; tarsal segments also obscured apicad; claws pale ochreous tipped with black and provided with distinct, though small, subapical inferior tooth. Femoral spines black, 3 (or 4)-4-5, moderately short, a little shorter than interspaces.

Wings hyaline; neuration brown; Ab meeting wing margin distal to Ac for a length equal to Ac itself; Arc a little distal to Ax_2; costal side of q in fore wing shorter than proximal side and less than one-half length of distal side, in hind wing one and one-half times length of proximal side and equal to distal side. Origin of M_3 and Rs closely approximated, but not fused, M_3 at subnodus, Rs slightly distal to it. Postnodal cross veins of first series 13-14 in fore wing, 13 in hind wing. Pterostigma short and high, proximal side more oblique than distal side and equal in length to anal side; color black, heavily framed in black.

Abdomen slender, terminal segments moderately expanded; dorsum and upper part of sides black with dark metallic-green luster, marking on segment 1 restricted to dorsum in basal half and the one on 2 somewhat constricted beyond middle; 2 to 7 each with tiny yellow basal annules, interrupted in median line, those on 2 and 3 being very narrow; 8 to 9 wholly black, 10 with only dorsum and upper part of sides obscured, the rest dirty ochreous; appendages also pale-colored tipped with black. Posterior border of segment 10 and anal appendages as in figure 7, *a-c*.

Abdomen 32.5 mm., hind wing 22.0 mm.

Female: Unknown.

Holotype, male (US 65138), Mt. Ngihneni, 730 m., Ponape, June-Sept. 1950, Adams.

DISTRIBUTION: Eastern Caroline Is. (Ponape).

This species is allied to *Teinobasis fortis*; but it differs markedly in the more open venation, in the more slender forms, and in the contrastingly colored femora.

7. **Teinobasis fortis** Lieftinck, n. sp. (fig. 7, *d-g*).

Male: Labium, mandibles, and genae upward to level of antennae light yellow; mandible bases with squarish black central dot. Labrum black, its anterior border light ochreous. Anteclypeus brown, postclypeus glossy black with vestige of a yellow spot on either side along anterior border. Frons almost rectangulate, transverse ridge straight, acute; color shiny black with faint bronze luster. Head, including rear, otherwise black, vertex and epicranial lobes dark metallic green; ventral surface of genae on each side of labium light ochreous. Antennae dark brown.

Posterior lobe of prothorax short and broad, but protuberant medially and gently upcurved, surface somewhat concave laterally, posterior border slightly thickened, gently rounded. Pro- and synthorax wholly obscured, brownish black or black, episterna and epimera of mesothorax metallic blue green. Prothorax almost entirely, ante-alar triangles,

mesostigmal area, and most of pleurae and ventral surface coarsely and densely pruinescent blue.

Ground color of legs light ochreous, but most of coxae, femora, and tibiae exteriorly very dark brown, coxae and tibiae mostly pruinescent blue, only trochanters remaining yellow; apices of tibiae and all tarsal segments light brown, claws tipped with black and with mere indication of an inferior subapical tooth. Femoral spines strong, black, 3-4-4, all a little shorter than interspaces.

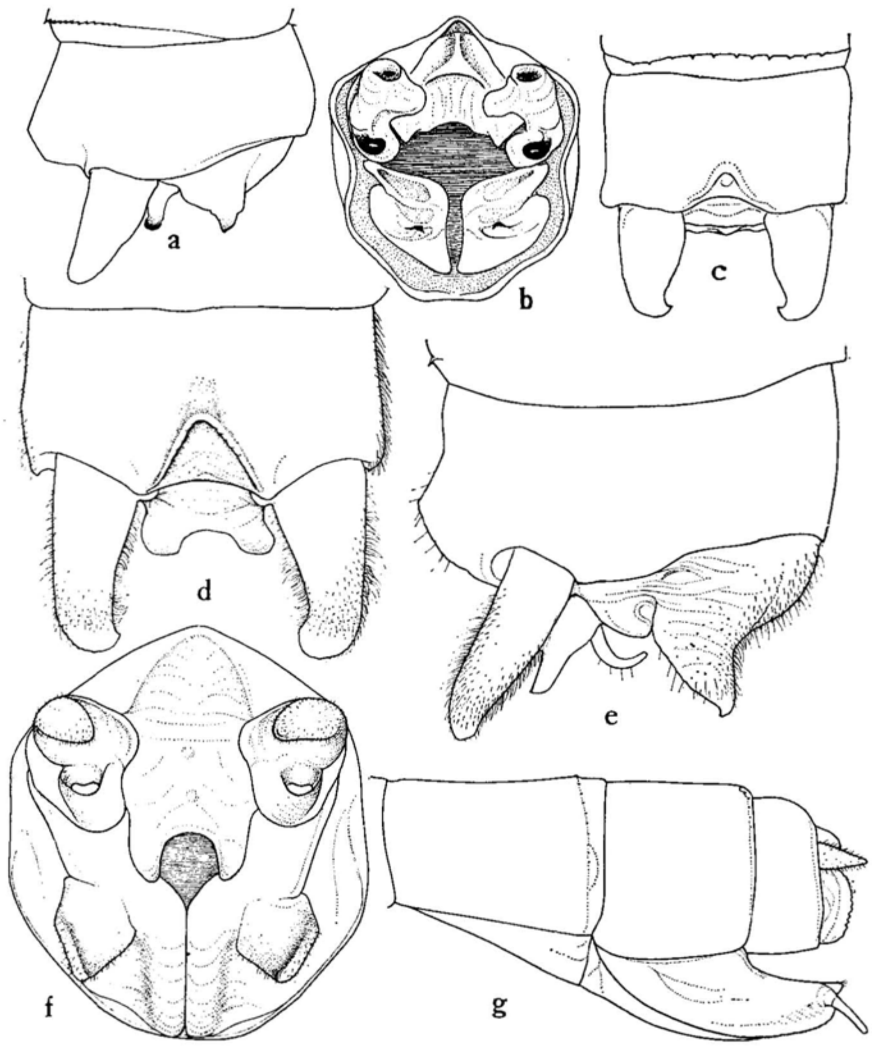


FIGURE 7.—**a-c,** *Teinobasis ponapensis,* anal appendages of male holotype: *a,* right side; *b,* caudal view; *c,* dorsal view. **d-g,** *T. fortis: d,* anal appendages of male, dorsal view; *e,* right side; *f,* caudal view; *g,* apex of female abdomen, left side view.

Wings slightly but distinctly tinged with gray yellow; Ab meeting wing margin distal to Ac for distance equal to Ac itself; Arc at Ax_2; costal and proximal sides of q in fore wing equally long, costal side slightly less than one-half length of distal side, in hind wing one and one-half times length of proximal side and equal to distal side; M_3 and Rs distinctly separated at origin; base of M_3 curved and originating well before subnodus, Rs at or a trifle distal to it. Postnodal cross veins 17-18 in fore wing, 15-16 in hind wing. Pterostigma oblique, lozenge-shaped, equilateral with parallel sides; color light brown surrounded by fine yellowish line and heavily framed in black. At least several marginal cells between C and R_1 distal to pterostigma divided.

Abdomen long and slender, apical segments moderately expanded; color dull bronze black, only dorsum of 2 to 4 with dark metallic green luster; light markings obscured and reduced to pale lateral mottling of 1 and diffuse brownish stripe along lower tergal margin of 2 to 6; 3 to 7 with narrow yellow basal ring, interrupted in median line; 8 to 10 and appendages dull black, intersegmental membrane dirty yellowish. Segment 1 entirely, dorsum of 2 in basal two-thirds, 6 and 7 along ventral margin, and entire surface of 8 to 10 overlaid with coarse, gray-blue pruinescence. Posterior border of segment 10 and anal appendages as in figure 7, *d-g*.

Female: Differs from male as follows. Whole anterior surface of head including vertical surface of frons light chrome except labrum, which is dark brown surrounded by yellow, and postclypeus, which is lighter brown. Antennae with first two segments yellowish, anterior faces of 1 and apex of 2 dark brown, flagellar segments brown. Dorsal surface of head with tiny yellow spot on each side between lateral ocellus and base of antenna. Posterior lobe of prothorax extremely short, deeply and broadly emarginate, margin slightly raised on each side of widely U-shaped excavation and forming a low knoblike tubercle, lateral divisions of lobe simply rounded and extending more laterad on lower level than tubercle. Mesostigmal plates transverse, more or less tongue-shaped, widest medially, apices silghtly projecting laterad; anterior connecting ridge raised and swollen.

Color dark bronze brown almost as far down as metapleural spiracle, sides of the thorax otherwise brownish yellow, paler underneath. Dorsum of prothorax, ante-alar triangles, and part of thoracic pleurae pruinescent blue. Legs dirty ochreous, only apex of femora brown; spines black; tarsal claws with vestigial blunt subapical tooth.

Wing membrane subhyaline, venation brown; origin of M_3 and Rs variable: M_3 distinctly curved as in male, but often veins shifted proximad, M_3 arising slightly before, Rs a little distal to subnodus, the two veins occasionally closely approximated and originating almost from one point near subnodus. Pterostigma cinnamon gray surrounded by pale yellow; several divided cells between C and R_1 distal to pterostigma.

Abdomen long, stout, segments 1 to 7 cylindrical and of even width throughout; terminal segments little broader but markedly expanded dorsoventrally. Dorsolateral bands progressively widening posteriorly, lower portion of sides of 2 to 5 more broadly pale colored than in male; 1 dirty ochreous with dark-brown apical ring, sides pruinescent; 2 to 7 with transverse yellowish basal spots more broadly interrupted medially than in male. Apical segments, including sternites and genital valves, predominantly brownish yellow, mottled with dark brown on dorsum. Valves not surpassing tuberculum supraanale, the latter as well as anal appendages sandy yellow (fig. 7, *g*).

Male: Abdomen 34.0 mm., hind wing 22.5 mm. (type); *female:* 32.0, 24.5 mm. (allotype); *male:* 32.5-35.5, 22.0-24.0 mm., *female:* 34.0, 25.0 mm. (paratypes).

Holotype, male (US 65139), Mt. Nahnalaud, Ponape, June-Sept. 1950, Adams; allotype, female, same data. Paratypes (KU, MCZ, BISHOP, CM), all Ponape: Male (incomplete), same data as for types; male (incomplete), Mt. Tolomain, Feb. 1936, Hirasawa; "*Teinobasis* spec.," det. J. G. Needham; male and female, Agric. Exper. Sta., June-Sept. 1950, Adams; two males, Mt. Dolotomw, southeast, and Mt. Ngihneni, 730 m., June-Sept. 1950, Adams; male, Net District, Nanipil, 300-450 m., "mountain stream," Mar. 1948, Dybas; male, Nihpit-Rohnkiti, Jan. 1938, Esaki.

DISTRIBUTION: Eastern Caroline Is. (Ponape).

This species is distinguished from all others by its sturdy build, densely veined wings, and somber body colors.

8. Teinobasis nigrolutea Lieftinck, n. sp. (fig. 8, *e-g*).

Male: Labium, mandibles, and genae as far upward as base of antennae light chrome; an oval, deep-black central spot at base of mandibles. Labrum smooth and shiny, bright chrome, marked basally with tripartite deep-black spot, median part of this marking rounded, lateral parts more or less triangular and continuous with black spot on mandibles. Anteclypeus yellowish, postclypeus glossy black. Frons obtuse angulate, transverse ridge little developed, somewhat swollen and elevated laterally; color black, vertical surface with transverse yellow streak each side in front of antennae. Head including rear otherwise unicolored metallic greenish black, ventral surface of genae on both sides of labium pale yellow. Base and intersegmental rings of antennae yellow.

Posterior lobe of prothorax short and broad, free margin only slightly swollen and little upcurved, evenly and broadly rounded. Prothorax bright chrome, dorsum of median division and entire anterior and posterior lobes dull black, only lateral edges of posterior lobe narrowly chrome. Synthorax ground color bright orange chrome, with dorsum and upper part of sides sharply defined in dark metallic green as follows: mesepisternum and mesepimeron including ante-alar triangles and axillae, color further extending posterodorsally to first lateral suture but posteroventrally to little beyond that level as far as about two-thirds distance between humeral suture and metaspiracle, boundary line curving back along mesinfraepisternal suture; anterior three-fifths of mesinfraepisternum concolorous with dark mesepisternum; three dark metallic green points, one at upper end just outside humeral, one at second lateral suture, and one at posterodorsal edge of metepimeron. Yellow point at upper end of humeral suture; sides and ventral surface of thorax orange chrome.

Legs orange chrome; sharply defined black stripe along outer face of all femora extends about apical half of first pair and three-fourths second and third pairs, these stripes abruptly expanded apicad, knees thus deep black exteriorly; inner surface of tibiae with narrow brown stripe tapering away about one-fourth distance from base; apex of all tibiae and ultimate tarsal segment narrowly brown; claws with distinct subapical inferior tooth. Femoral spines black, 3-4-4, all a little shorter than interspaces.

Wings hyaline; Ac only little proximal to level of Ax_2, Ab and Ac meeting wing margin together; Arc at Ax_2; costal and proximal sides of q in fore wing equally long, costal side about half as long as distal side, in hind wing one and one-half length of proximal side and equal to distal sides; M_3 and Rs well separated at origin, base of M_3 curved and originating a little before subnodus, Rs at or a trifle distal to it. Pterostigma oblique, lozenge-shaped but distinctly longer than high, sides parallel, color brownish yellow centered with brown. Postnodal cross veins of first series 12-14 in fore wing, 12-13 in hind wing.

Abdomen slender, apical segments a little more abruptly expanded than in *fortis* and *carolinensis*; segment 1 bright orange chrome except a thick black stripe restricted to dorsal surface bordering posterior margin; 2 deep metallic greenish black, lower half of sides chrome; 3 to 7 also black, with slight metallic green luster, unmarked except narrow yellow stripe along lateroventral border; 8 to 10 including intersegmental membranes orange chrome, dorsum and upper two-thirds of 8 and 9 wholly black, marking on 9 not entirely reaching posterior border; 10 and appendages orange chrome, only apices of appendages tipped with black. Posterior border of segment 10 and anal appendages, as in figure 8, *e-g*.

Female: Resembles male, apart from sexual characters differing only as follows. Tripartite mark at base of labrum reduced and obliterated; black mark on mandibles also smaller and disconnected from lateral spot on labrum; transverse yellow streaks in front of frons larger though not touching in median line. Posterior lobe of prothorax depressed, distinctly shorter and also a little broader than in male, shortly quadrilobate, midlobe also

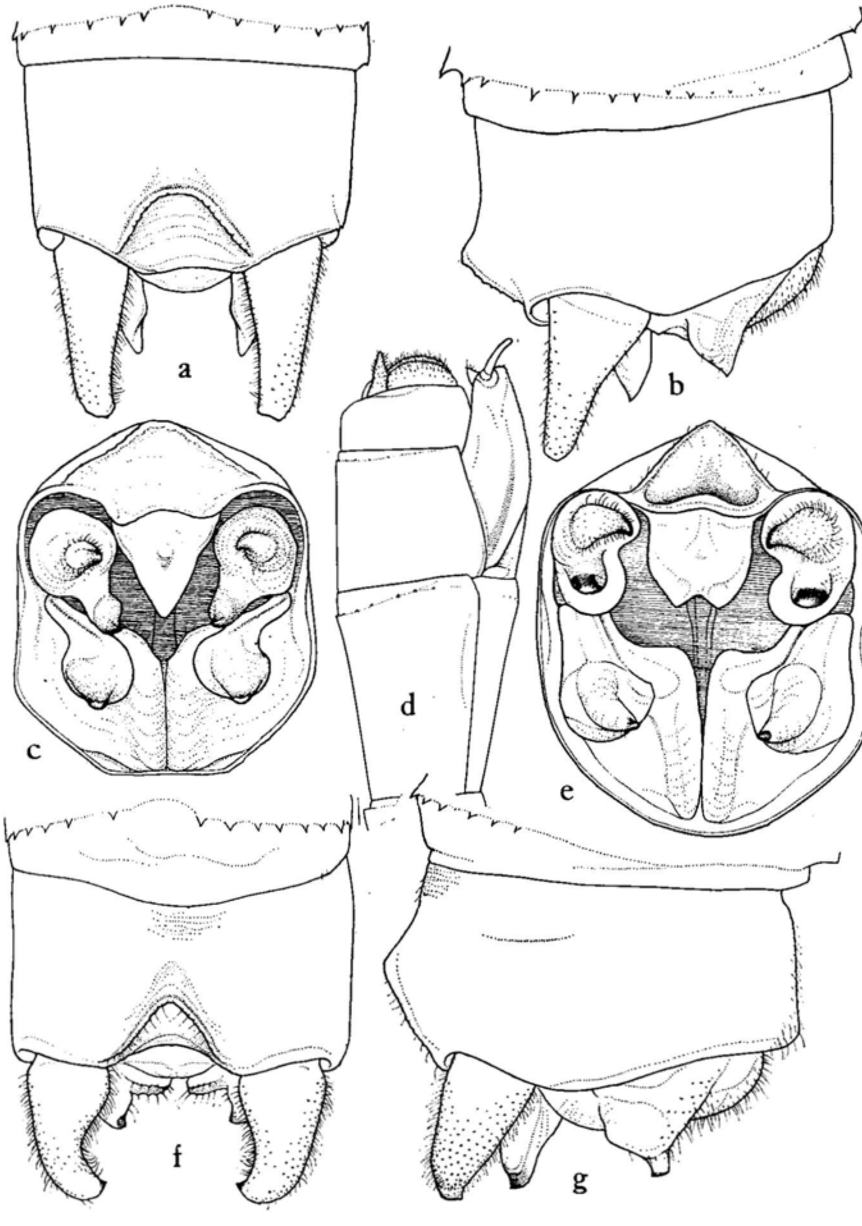


FIGURE 8.—**a-d,** *Teinobasis ariel: a,* anal appendages of male, dorsal view; *b,* right side; *c,* caudal view; *d,* apex of female abdomen, left side view. **e-g,** *T. nigrolutea,* anal appendages of male: *e,* caudal view; *f,* dorsal view; *g,* right side view.

shallowly emarginate, posterior border in dorsal view appearing undulated; lateral lobes a little narrower and more prominent than in male. Mesostigmal plates transverse, subtrapezoidal with rounded edges. Legs as in male but black exterior stripe of femora abbreviated, only knees deep black exteriorly, the apical spots thus formed prolonged basad for a short distance along posterior carina. Wings as in male, but Ab entering wing margin at a point distal to Ac for a distance equal to Ac itself in all wings; Arc a little distal to Ax_2 in right pair of wings; M_3 and Rs in fore wing more closely approximated at origin than in male, in left hind wing distinctly separated but in the right very close and fused for a short distance.

Abdomen colored similarly to male; segments 1 (except a dark line along posterior border), 9 and 10, the sternite of 8, genital valves, and appendages all light orange chrome, only dorsum of 9 with some basal obscuration; inner valves deep black. Posterior border of segment 10 with tiny V-shaped emargination; valves surpassing apex of segment 10 for about middorsal length of this segment.

Male: Abdomen 29.8 mm., hind wing 20.0 mm. (type); *female:* 28.5, 20.5 mm. (allotype); *male:* 29.0-30.0, 19.0-20.0 mm., *female:* 28.0-30.5, 20.0-23.0 mm. (paratypes).

Holotype, male (US 65140), south of Nanpohnmal, Ponape, Jan. 17, 1953, Clarke; allotype, female, same data. Paratypes (US, BISHOP, CM), all Ponape: Four males, four females, same data as for types and north slope of Mt. Temwetemwensekir, 70-80 m., Jan. 1953, Clarke and Gressitt; male, Net District, Nanipil, river margin, Feb. 1948, Dybas.

DISTRIBUTION: Eastern Caroline Is. (Ponape).

This is a conspicuous species, easily recognized by the sharply pronounced orange and black body markings.

9. **Teinobasis ariel** Lieftinck, n. sp. (figs. 8, *a-d*; 9).

Male: Labium pale yellow; genae upward to a level about halfway to postclypeus and antennal base greenish yellow. Labrum, mandible bases, and postclypeus blackish brown, mandibles with pale basodorsal spot and both labrum and postclypeus often intermingled with lighter brown at base; anteclypeus, vertical surface of frons, antennal sockets anteriorly, and first two antennal segments dirty brownish yellow. Head, including rear, otherwise dull bronze black, dorsal surface marked with distinct, oblique, brownish-yellow streak on each side between lateral ocellus and antennal base; ventral surface of genae on each side of labium brownish yellow. Frons rectangulate, transverse ridge straight and acute.

Posterior lobe of prothorax short and broad, surface slightly convex but posterior border slightly swollen and upturned, evenly and broadly rounded. Ground color of pro- and synthorax cinnamon marked with dark bronze brown, as follows: Prothorax bronze brown, darkest above, anterior and posterior lobes dirty yellowish, the latter with a black median spot at extreme base. Dorsum of synthorax, laterally as far as three-fourths distance between humeral suture and metaspiracle, dark bronze brown, boundary in line with downward prolongation of first lateral suture, color rather dull; shoulder area and additional dark-brown area filling out upper one-fourth of metepisterna darker in tint and shinier than the rest, metepisternal mark more or less wedge-shaped, abbreviated along second suture; ante-alar triangles lighter brown. A sharply defined, though narrow and incomplete, light yellow juxtahumeral (mesepimeral) stripe, widest dorsally, extends ventrad about four-fifths whole length, tapering away gradually downward; mesinfraepisternum, except narrow posterior area, dark brown, this color separated from dark mesepimeral band by diffuse yellowish sutural line; metepimeron with indication of a cloudy brown mark upon middle of upper one-fourth and with dark points at upper edges; ventral surface pale-colored.

Legs dirty pale cinnamon; femora slightly darker between outer carinae and with faintest indication of a brownish subapical ring; outer faces of knees darker brown, as

and antennal base greenish yellow. Labrum, mandible bases, and postclypeus blackish

are also tips of apical tarsal segments; tarsal claws with distinct, though often small and blunt subapical inferior tooth. Femoral spines brown, 3 (or 4)-7-8, relatively fine, progressively longer from base to apex, distal ones about twice longer than interspaces.

Wing membrane brownish yellow; neuration brown; Ab meeting margin distal to Ac for distance equal to Ac itself or a little less; Arc at or slightly distal to Ax_2; costal and proximal sides of q in fore wing equally long, costal side slightly less than one-half length of distal side, in hind wing one and one-half length of proximal side and equal to distal side; origin of M_3 and Rs variable, Rs at subnodus, but M_3 either arising well before or very near to it and either almost straight or distinctly curved. Postnodal cross veins of first series 13-16 in fore wing, 13-15 in hind wing. Pterostigma moderately oblique, a little longer than high, proximal side slightly more oblique than distal side; color blackish brown, almost black. Rarely one or two divided cells between C and R_1 distal to pterostigma.

Abdomen slender, apical segments moderately expanded; color yellowish brown marked with dull bronze brown without metallic luster; sides of 1 and 2 and extreme base of 2 yellowish, 3 to 6 with fairly distinct, though narrow, yellow basal annules and with pair of indistinct tiny dorsolateral spots of same color immediately in front of brown apical rings; lateroventral margin of tergites slightly paler than the rest, but all markings poorly defined; 7 to 10 and appendages unicolorous brown, somewhat lighter than on preceding segments, intersegmental membranes brownish yellow. Posterior border of segment 10 and anal appendages as in figure 8, *a-c*.

Female: Closely similar to male; differs as follows. Labrum and postclypeus lighter, rather more ochreous deepening to dark brown anteriorly. Posterior lobe of prothorax distinctly shorter, its surface transversely wrinkled, somewhat convex, posterior border shallowly emarginate, whole structure a little swollen and elevated medially, median division minutely wrinkled, carrying two low dorsal ridges, diverging toward base; no dark median spot at base of posterior lobe. Mesostigmal plates transverse, oblong, with rounded edges. Pterostigma slightly noticeably paler than in male.

Thoracic and abdominal markings as in male, brown dorsal bands of abdominal segments somewhat narrower, more restricted to dorsum, becoming gradually less defined from before backwards, merging into ground color posteriorly; basal yellow annules of 2 to 6 a little larger; apical segments and genital valves as in figure 8, *d*.

Male: abdomen 27.0 mm., hind wing 17.0 mm. (type); *female:* 26.5, 18.0 mm. (allotype); *male:* 28.0-34.0, 17.5-21.0 mm., *female:* 25.0-28.0, 17.0-19.0 mm. (paratypes).

Holotype, male (US 65141), Agric. Exper. Sta., Ponape, June-Sept. 1950, Adams. Paratypes (MCZ, KU, US, BISHOP, CM), all Ponape. Six males, same data; several, both sexes, Colonia, Mts. Dolotomw (S.E.), Ngigneni, 730 m., Nahnalaud, Paipalap, 60 m., and Temwetemwensekir, 420 m., June-Sept. 1950, Adams; four males, Wene-Nihpit and Nihpit-Kapiroi-Lehdau, July 1939, Esaki; two males, Colonia-Palikir, Dec. 1937 and July 1939, Esaki; two males, one female, Colonia-Nanipil, Madolenihm-Nihpit, and Nanipil-Mt. Dolen Eireke, Jan. 1938, Esaki; one pair, Mts. Dolen Kiepw and Pairot, July 1949, Owen; male, S. of Nanpohnmal, Jan. 1953, Clarke; two females, north slope of Mt. Temwetemwensekir, 180 m., Jan. 1953, Clarke and Gressitt; three males, Net distr., Nanipil, Feb. and forest trail, Mar. 1948, Dybas; male, Colonia, near sea level, Mar. 1948, Dybas; male, Uh distr., Awakpah, rocky stream, Mar. 1948, Dybas. Paratype, Sokehs I., male, (Jokai), Feb. 1948, Dybas.

DISTRIBUTION: Eastern Caroline Is. (Ponape).

This new species varies considerably in size and venational features, even

shallowly emarginate, whole structure a little swollen and elevated medially, median divi-

in the length of the pterostigma, and specimens of different sizes may occur together in one locality. Some variation also exists in color, several examples having the ground color of the thorax and the basal annules of the abdominal segments definitely lighter than in the type; in well-preserved individuals, the thoracic pleurae, coxae, and sides of segment 1 of the body are thinly overlaid with a delicate, pale-blue pruinescence. In addition to the characters given in the key, the male *Teinobasis ariel* can be distinguished from *T. aerides* by the relatively longer and straighter upper branch of the superior appendages (figs. 8, *a-c*; 10, *a-c*).

The following is a brief account of the larva, most likely of *T. ariel* or else of *T. nigrolutea*. The specimens are quite similar structurally and probably conspecific, also resembling each other closely in size and markings. They are chiefly characterized by the very broad and medially expanded labium that reaches back to the end of the precoxae.

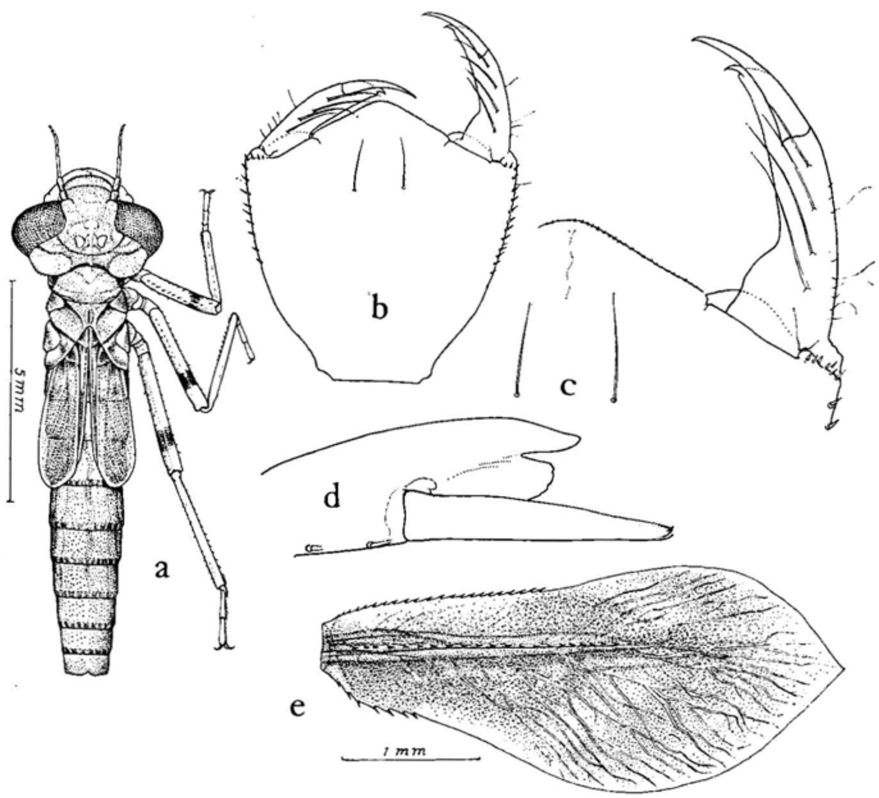


FIGURE 9.—*Teinobasis ariel*, ultimate instar larva: **a**, insect; **b**, inner view of labium; **c**, **d**, right labial palpus, more enlarged, and apex of same, viewed from within; **e**, median caudal lamella, left side view.

General appearance as in figure 9. Body smooth. Antennae 7-segmented; segment 2 one-third longer than 1, 3 almost twice as long as 2, 4 equal in length to 2, remainder decreasing gradually in length. Labium (fig. 9, *b-d*); distal edge of median premental lobe with row of minute claviform setae. Postocular lobes posteriorly beset with a number of short spinulose setae. All femora with distinct brown subapical ring. For further details, see figure 9 and the key to coenagrionid larvae.

One male ultimate (in alcohol), Nanpohnmal, Ponape, in *Freycinetia*, Jan. 1953, Gressitt. One ultimate and one penultimate female (dried and pinned), Mt. Temwetemwensekir, Ponape, 420 m., June-Sept. 1950, Adams.

10. Teinobasis aerides Lieftinck, n. sp. (fig. 10, *a-c*).

Male (holotype): Labium pale ochreous; genae and lateral surface of frons upward almost to level of median ocellus light green. Labrum, mandibles, clypeus, and anterior surface of frons ochreous orange, labrum with brown mid-basal point and side edges also obscured, postclypeus with diffuse brown basal line at frontal suture and pair of ill-defined brown dots on each side along distal margin. Frons shaped similarly to *T. ariel;* horizontal portion dull bronze black, as are vertex and epicranium; small oblique yellowish streak each side between lateral ocellus and base of antenna; ventral surface of genae, on each side of labium, light green; rear black.

Posterior lobe of prothorax shaped as in *T. ariel*, but distinctly more prominent medially, free margin broadly and evenly rounded. Ground color of pro- and synthorax brighter than in *ariel*, orange yellow marked with dull bronze black as follows. Prothorax except lateral edges of anterior lobe, stripe along lateroventral margin of median division, and posterior lobe, which remain ochreous; posterior lobe, with crescent-shaped median black spot at extreme base. Dorsum of synthorax dull metallic greenish black, as far down as described for *ariel*, except that oblique dark patch filling out upper part of metepisternum better defined, coppery shiny, and narrowly indented by yellow halfway down metaspiracle at first lateral suture; ante-alar triangles shiny metallic green bordered with light brown. Sharply defined bright citron yellow juxtahumeral streak, tapered on both ends (length 1 mm.), situated 0.6 mm. from dorsal carina. Thoracic sides and undersurface otherwise as in *ariel*, but metepimeron unmarked, except some black points at upper edges.

Legs warm buff to cinnamon buff, femora slightly darker between exterior carinae and with faint indication of brownish subapical ring; outer face of knees darker brown, but tarsi unmarked; tarsal claws with distinct (though small and blunt) subapical inferior tooth. Femoral spines brown, stronger than in *ariel*, progressively longer from base to apex, 3-6-? (missing), distal spines slightly longer than interspaces.

Wings shaped as in *T. ariel*, but neuration more open; membrane slightly tinged with brownish yellow; neuration brown. Ab coalesces with wing margin only slightly distal to point where Ac enters margin; Arc distinctly distal to Ax_2 in all wings; costal side of q in fore wing a little shorter than proximal side and half length of distal side, in hind wing almost twice as long as proximal side and a little longer than distal side; M_3 originates well before subnodus, Rs at subnodus. Postnodal cross veins of first series 12 (one wing 13). Pterostigma larger and distinctly shorter than in *ariel*, lozenge-shaped, proximal side slightly more oblique than distal; color pale cinnamon, somewhat darker centrally. No divided cells between C and R_1 distal to pterostigma.

Abdomen considerably longer than in *T. ariel*, ground color lighter, orange yellow on segment 1 and base of 2, brown dorsal marks narrower, those on 1-2 restricted to dorsal surface, one on 2 markedly constricted after middle; basal yellow annules of 3-7 similar to *ariel*, brownish yellow; dorsum of 8-9 and base of 10 brown. Posterior border of segment 10, configuration of its inferior dorso-apical process, and appendages, almost identical in shape to same structures in *ariel;* upper branch of superior appendages relatively a little shorter and more incurved, lower branches more divaricate and completely hidden in dorsal view (fig. 10, *a-c*).

Abdomen 38.5, hind wing 22.0 mm.

Female: unknown.

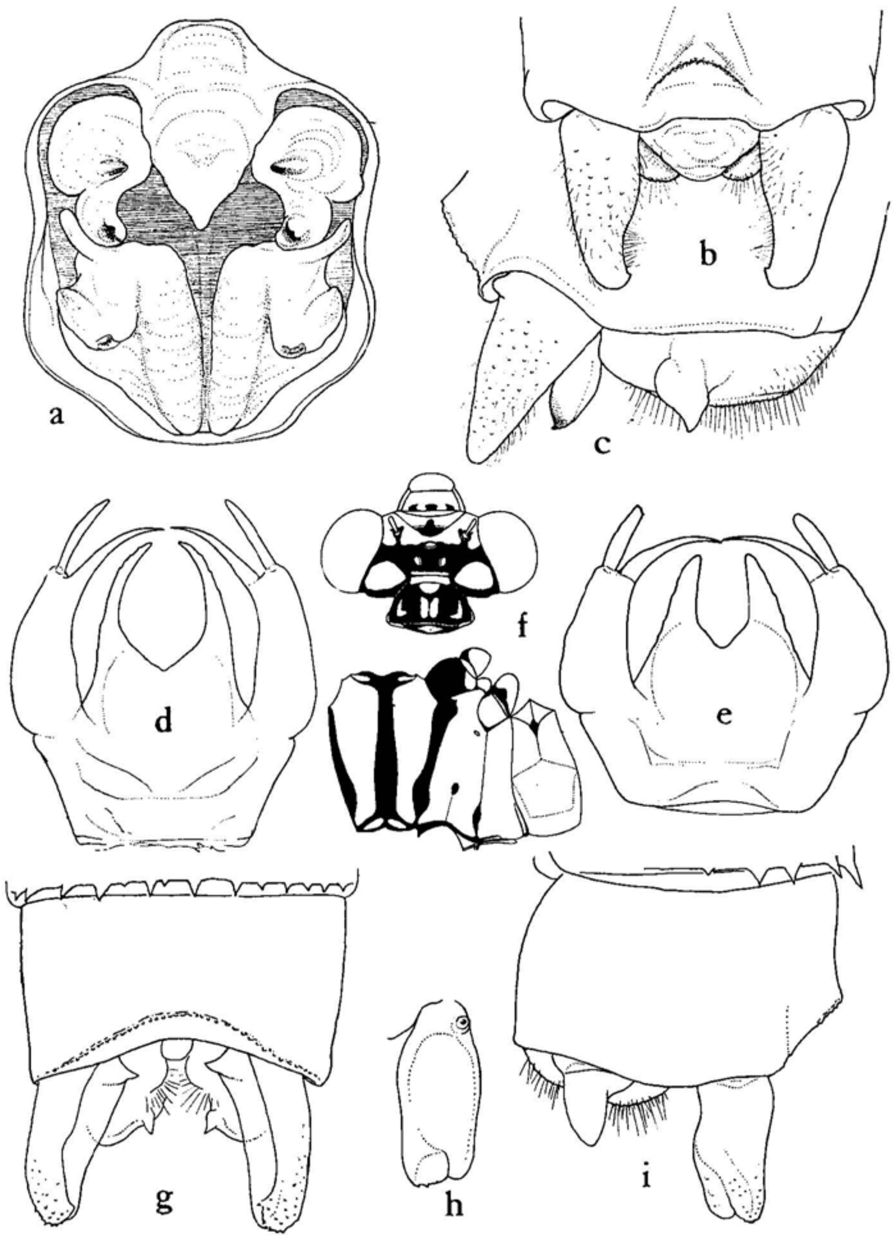


FIGURE 10.—**a-c**, *Teinobasis aerides*, anal appendages of male: *a*, caudal view; *b*, dorsal view; *c*, right side view. **d**, *T. superba*, labium of male, inner view. **e**, *T. carolinensis*, labium of male, inner view (bristles omitted). **f-i**, *Pseudagrion palauense*, male holotype: *f*, color pattern of head and thorax; *g*, anal appendages, dorsal view; *h*, left superior appendages, inner view; *i*, left lateral view.

Holotype, male (US 65142), Mt. Pairot, 660 m., Ponape, June-Sept. 1950, Adams.

DISTRIBUTION: Eastern Caroline Is. (Ponape).

Genus **Pseudagrion** Selys

Pseudagrion Selys, 1876, Bull. Acad. Roy. Belgique **42** (2): 490-492 (type: *Agrion furcigerum* Rambur, 1842, Hist. Nat. Ins. Neuropt., 261, male, *sine patria, rect.* Cape).

This is a genus of the tropical regions of the Old World with numerous species, many of which extend beyond these limits to the subtropics (south Palaearctic, South Africa, Australia). The only regional species belongs to a group whose representatives breed both in still and running water, but who prefer marshes and lakes in open country.

11. Pseudagrion palauense Lieftinck, n. sp. (fig. 10, *f-i*).

Allied to *P. starreanum* Lieftinck (1949, Nova Guinea, n. ser., **5**: 181), from west New Guinea, but with a shorter synthorax, somewhat more extensive black markings, and differently shaped anal appendages.

Male (holotype): Ground color of head and abdomen pure blue, of thoracic segments blue intermingled with green, similar to *P. microcephalum* (Rambur). Color pattern of head and thorax as in figure 10, *f*. Armature and coloration of legs as in *P. microcephalum*, but wings with apices more pointed, reticulation closer, and venation differing in several respects. Nodus situated more proximad, its distance from wing base much shorter than from pterostigma, difference of 3-4 postnodal cell lengths in hind wing (in *microcephalum* and *starreanum* only 1-2 cells); M_2 arising about midway between nodus and pterostigma, M_{1a} four cells further distad (in the other species both veins further removed outward); postnodal cross veins of first series 13-14 in fore wing, 11-12 in hind wing (9-11 and 8-9, respectively, in the species compared); pterostigma normal and quite similar is size and shape to that of *starreanum;* black surrounded by fine pale line.

Abdomen blue; all bronze-black markings more extensive than in *starreanum,* segments 4 to 7 lacking blue basal annules invariably present in allied species; 1 with square black mark occupying basal five-sixths of dorsum; 2 with T-shaped black mark on distal half covering middle of dorsum, stem of T very slender; 3 to 7 black dorsally, these marks successively broader from before backwards, but only the one on 3 tapering to a short point basally leaving pair of blue spots interrupted in median line when viewed from above; 8 and 9 entirely blue, only posterior border including marginal spines finely black; 10 blue except entire dorsum. Anal appendages as in figure 10, *g-i;* color of both pairs black, striped with blue on inner surface.

Male: abdomen 27.7 mm., hind wing 17.2 mm.

Female: unknown.

Holotype, male (KU), Melekeiok-Ngardok Lake, Babelthuap, Palau, Feb. 24, 1936, Esaki.

DISTRIBUTION: Western Caroline Is. (Palau).

This species is closely allied to *P. microcephalum* (Rambur) and related species of the same group. The larvae of all are chiefly characterized by the angularly projecting occipital lobes of the head, which are here figured for

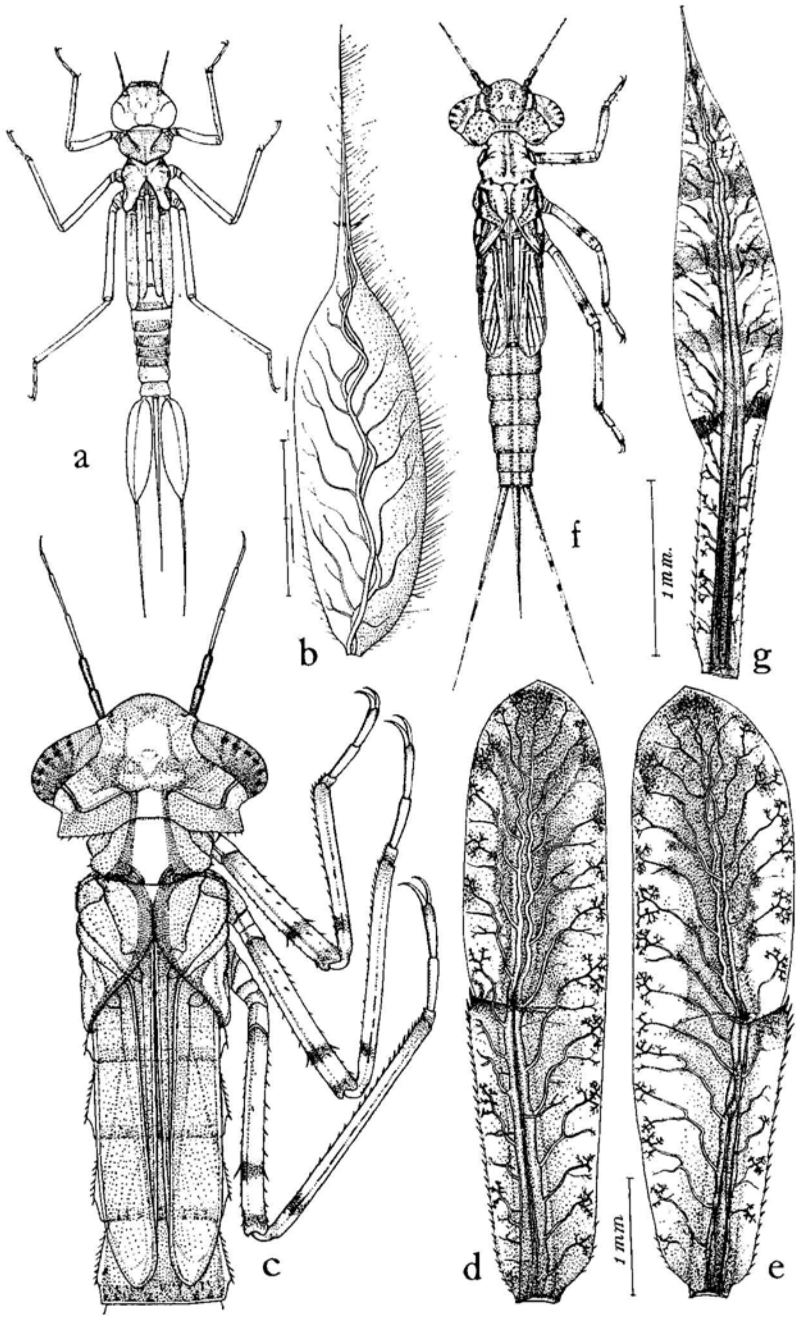


FIGURE 11.—**a, b,** *Drepanosticta sundana,* western Java (after Lieftinck, 1934): *a,* larval exuvia; *b,* median caudal lamella. **c-e,** *Pseudagrion microcephalum,* western Java: *c,* anterior portion of ultimate instar larva, live specimen; *d, e,* lateral and median caudal lamellae of same specimen. **f, g,** *Agriocnemis f. femina,* western Java; *f,* ultimate instar larva, live specimen; *g,* median caudal lamella of same specimen, right side view.

P. microcephalum, the commonest and most widely distributed species (fig. 11, *c*). All species of the group agree fairly closely in the beautiful nodate type of caudal gill lamellae and the structure of the labium (figs. 11, *d-e*; 12).

Genus **Ischnura** Charpentier

Ischnura Charpentier, 1840, Libell. europ., 20 [type: *Agrion tuberculatum* Fabricius (1825, Hor. Ent., 22) = *Agrion elegans* Van der Linden, 1820].
Boninagrion Asahina, 1952, Mushi **23**: 51-52, figs. (types: *B. ezoin* Asahina, loc. cit., Bonin Is.; n. syn.).

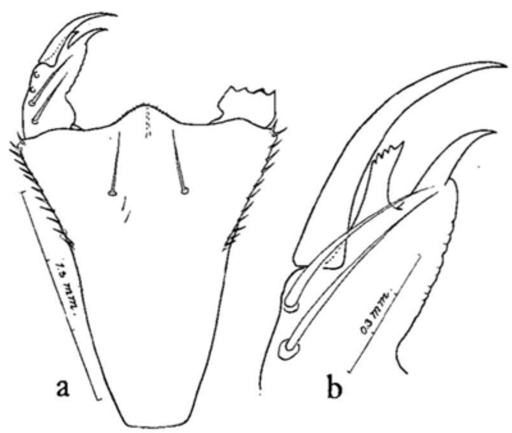


FIGURE 12.—*Pseudagrion microcephalum*, western Java: **a**, inner view of labium; **b**, left labial palpus, more enlarged.

KEY TO MICRONESIAN SPECIES AND SUBSPECIES OF ISCHNURA

1. *Male:* Abdominal segments 3 to 6 almost entirely red; segment 8 at least apically and 9 entirely blue; posterior ridges of mesostigmal laminae elevated toward their mesal extremities, forming prominent horn-like processes; labrum orange, variably marked with black along base; postocular spots circular, blue; venation partly reddish or yellowish; pterostigma of fore wing partly rose red. *Female:* Heterochromatic, regional androchromatic (red) individuals being unknown; ground color greenish yellow, bronze black above, in adult insect pruinescent whitish; no postocular pale spots, but antehumeral stripes present, all abdominal segments bronze black. Size of regional specimens variable, abdomen 16.0-22.0 mm., hind wing 10.0-14.0 mm.; 7-8 Px of first series in fore wing, 5-6 in hind wing (both sexes)........................**12. aurora**
   Male: Abdomen with no red coloration; remaining characters not as above. Larger species 2

2(1). *Male:* End of segment 10 of abdomen obtuse angulate in side view, produced medially into low projection, much broader than high when viewed from behind and terminating in two roundish tubercles. Anal appendages short, superiors thick and blunt, equal in length to inferior pair (fig. 13, *i, j*); segments 8 and 9 blue, except rather broad black basodorsal annule of 8

and narrow black basal and apical rings of 9 (both sexes). Pterostigma of male fore wing black surrounded by a yellow line most pronounced at costal apical angle; costal side distinctly shorter than anal side; 9-10 Px of first series in fore wing, 7-8 in hind wing. Abdomen 22.6-26.0 mm., hind wing 15.5-17.5 mm. (both sexes) .... **15. torresiana**

Male: End of segment 10 of abdomen acute angulate in side view, markedly prominent, terminating in bifid tubercle. Superior anal appendages shorter than inferior pair. Remaining characters not as above 3

3(2). *Male:* Pterostigma of fore and hind wing dissimilar in size, but distal side of fore wing pt not very oblique and apical angle not very acute, color brownish black in all wings surrounded by fine whitish line (fig. 13, *h*). Blue postocular spots medium-sized, pear-shaped or subtriangular; complete black stripe over second lateral suture of thorax; distal one-third of abdominal segment 8 and entire surface of 9 and 10 blue. Wings densely reticulated, 12-14 Px of first series in fore wing, 11-13 in hind wing. Superior anal appendages long and downcurved in side view, reaching only half length of inferior pair, which in side view are triangularly pointed, projecting obliquely upward beyond superiors. *Female:* Androchromatic, but ground color of body orange and with dorsum of segments 8 to 10 of abdomen black. Larger species, abdomen 27.0-29.5 mm., hind wing 17.0-21.0 mm. (both sexes) .... **14. ezoin**

Male: Pterostigma of fore and hind wing dissimilar in size and color, pt of fore wing oblique and acutely pointed at outer end, its costal border whitish; color black, but outer angle of fore wing pt white tinted with blue on upper surface. Blue postocular spots small, circular; no black stripe over second lateral suture of thorax; only segment 8 of abdomen blue (except a black basodorsal annule), 9 black. Neuration more open, 9-10 Px of first series in fore wing, 8-9 in hind wing. Superior anal appendages small, blunt, and tubercular, interior spine clearly visible in side view, scarcely half as long as inferior pair, which in side view are long thumb-shaped processes directed obliquely upward. *Female:* Dichromatic, heterochromatic (orange) color form preponderating. Smaller species, abdomen 25.0-26.5 mm., hind wing 16.0 mm. (both sexes) .... **13. senegalensis**

12. Ischnura aurora aurora (Brauer).

Agrion delicatum Hagen, 1858, Zool.-bot. Ges. Wien, Abh. **8**: 479 (*nom. nud.*, Ceylon).

Agrion aurora Brauer, 1865, Zool.-bot. Ges. Wien, Abh. **15**: 510 (male, female, Tahiti).

Agrion (Ischnura) aurora, Brauer, 1866, Novara Exped., Zool. 1, Neuropt.; 56-57, pl. 1, fig. 12 (male, female, Tahiti).

Agriocnemis amelia Needham, 1930, Zool. Sinica, ser. A, **11**: 255-256, pl. 19, fig. 4 (Hainan).—Chûjô, 1942, Ent. Lab. Taihoku Imp. Univ., contr. **90**: 127 (Hainan).

Ischnura aurora, Schmidt, 1938, Ent. Soc. Am., Ann. **31**: 324, 336 (catalog); 1941, Deutsch. Ent. Ges., Mitt. **10**: 23-25, fig. 1 (Marianas, variation).

Ischnura delicata, Swezey and Williams, 1942, B. P. Bishop Mus., Bull. **172**: 3 (Guam).

Ischnura aurora aurora, Lieftinck, 1949, Nova Guinea, n. ser., **5**: 220-222, 261 (references, distrib., speciation; Marianas, after Schmidt).

DISTRIBUTION: India and Ceylon through southeast Asia to Polynesia (Tuamotu and Marquesas Is.) and New Zealand.

S. MARIANA IS. Saipan: Chalan Kanoa, Oct. 1937, Esaki; Achugau and Papako areas, Sadog Talofofo, Jan.-Feb. 1945, Dybas. Tinian: Hagoi Lake, Nov. 1937, Esaki; at light, Mar. 1946, Hadden. Rota: Songsong-Taipingot, Nov. 1937, Esaki; June 1951, Bohart. Guam: Various localities, e.g., Agana swamp, June 1945, Dybas, and Aug. 1945, Wallace; Oct. 1952, Krauss; Mt. Balanos, Aug. 1952, Krauss; Agana, Tutujan, Nov. 1952, Gressitt; Inarajan, Oct. 1957, Krauss.

YAP. Yap, July-Aug. 1950, Goss.

CAROLINE ATOLLS. Pingelap: July 1949, Owen.

TRUK. Wena (Moen): Apr. 1949 ?; Oct. 1952, Beardsley. Fefan I.: Mesa-Urunna, Nov. 1937, Esaki and Tanita. Ton (Tol): Apr. 1949; Mt. Unibot, Dec. 1952, Gressitt. Tonoas I. (Dublon): 1952, Gressitt.

PONAPE. Several localities, a.o., Rohnkiti-Palikir, Jan. 1938, Esaki; Nanipil, Net district, Feb.-Mar. 1948, Dybas; June 1949, Owen; June-Sept. 1950, Adams; Jan. 1953, Clarke.

KUSAIE. Lele I., Dec. 1937, Esaki and July 1949, Owen; Malem, Dec. 1937, Esaki; Mwot-Utwe, Dec. 1937, Esaki; Funaunpes, Jan. 1953; Malem, Feb. 1953, and Mutunlik, Apr. 1953; all Clarke.

MARSHALL IS. Wotje: Nov. 1937, Esaki. Ailinglapalap: Bikajela (Bigatyelang) I., Nov. 1948, Fosberg. Arno: Ulen I., July 1950, La Rivers. Kili: Oct. 1953, Beardsley. Uturik: two males, "from around pit well," Dec. 1951, Fosberg. Jaluit: Jabwar I., Sydney Pier, Apr. 1958, Gressitt.

GILBERT IS. Tarawa: Mar. 1951, Catala; Belio, Aug. 1956, Brown; Nov.-Dec. 1957, Krauss. Marakei: Nov.-Dec. 1957, Krauss. Butaritari: Nov.-Dec. 1957, Krauss. Onotoa: Tanyah I. (Buiartun), *babai* pits, July 1951, Moul.

This is a wind-borne and highly adaptive species, which breeds in stagnant fresh water of every kind, including taro pits and empty coconut shells. It is chiefly insular and coastal, but with isolated montane habitats in Java and New Guinea, and is usually extremely abundant where found. The species varies much in size; two males collected simultaneously on Jaluit (Jabor) measure as follows: abdomen 18.7, hind wing 10.0 mm.; and 22.0, 12.0 mm., respectively.

I. aurora was not among the extensive collections of Odonata I examined from the Ryukyus. I have recently described and illustrated the larva (1959, Nova Guinea, n. ser., **10**: 229-230, figs.).

13. Ischnura senegalensis (Rambur).

Agrion senegalense Rambur, 1842, Hist. Nat. Ins. Neuropt., 276-277 (male, female, Senegal).

Ischnura senegalensis, Asahina, 1952, Mushi **23**: 51, 53 (Chichi Jima, Haha Jima).

DISTRIBUTION: Old World tropics and temperate regions, from East Africa to Japan, the Ryukyus, Izu and the Bonin Is.; southeastward as far as the Moluccas.

BONIN IS. Minami Jima: Six males, two females, May 1958, Snyder. Ani Jima: Two males, Southwest Bay, May 1958, Snyder.

The larva of *I. senegalensis* has been briefly discussed by Lieftinck (1959, Nova Guinea, n. ser. **10**: 230).

14. Ischnura ezoin (Asahina). (Figure 13, *h.*)

Boninagrion ezoin Asahina, 1952, Mushi **23**: 51-53, pl. 8, figs. 17-26 (Bonin Is.; types, male, female, Chichi Jima); 1956, Shin Konchū **12**: 47-48 (Bonin Is.).

DISTRIBUTION: Bonin Is. (endemic).

BONIN IS. Chichi Jima: Two males, July 1951, Bohart; female, Miyanohama, Apr. 1958, Synder. Haha Jima: Female, Okimura, Apr.-May 1958, Snyder. Ani Jima: Two males, Southwest Bay, May 1958, Snyder.

This interesting endemic species is a true *Ischnura* in every respect. The pterostigma of male fore and hind wing are slightly dissimilar in shape (fig. 13, *h*).

15. Ischnura torresiana Tillyard (fig. 13, *i, j*).

Ischnura torresiana Tillyard, 1913, Linn. Soc. New South Wales, Proc. **37**: 452-453, pl. 48, figs. 5, 6 (Cooktown, North Queensland; lectotype: male, Cooktown).—Ris, 1913, Senckenb. Naturf. Ges., Abh. **34**: 515 (key), 516, pl. 23, fig. 10 (Aru Is.; south New Guinea; North Queensland).—Lieftinck, 1949, Nova Guinea, n. ser., **5**: 230, 261 (distrib., ref.); 1959, op. cit. **10**: 216, 218-219 (key, notes).

DISTRIBUTION: North Australia (*terr. typ.*); Torres Strait Is.; New Guinea; Aru Is.; New Hebrides and Banks I.; western Caroline Is. (Palau).

PALAU. Babelthuap: Male, Ngchesar-Ngardok Lake-Ngiwal, Aug. 1939, Esaki. Angaur: Female, Dec. 1949, Owen.

The anal appendages of a male from west New Guinea are illustrated (fig. 13, *i, j*).

Genus **Agriocnemis** Selys

Agriocnemis Selys, 1877, Bull. Acad. Roy. Belgique **43** (2): 142-143 (type: *Agrion pygmaeum* Rambur, 1842, Hist. Nat. Ins. Neuropt., 278, female, Ind. or.).

This genus comprises the smallest known species of Odonata. Only a single widely distributed species is known to occur within our faunal limits. It breeds, often in immense numbers, in marshes and rice fields. The larva of a Malaysian subspecies of *A. femina,* possibly *incisa* Selys, is semitransparent, straw

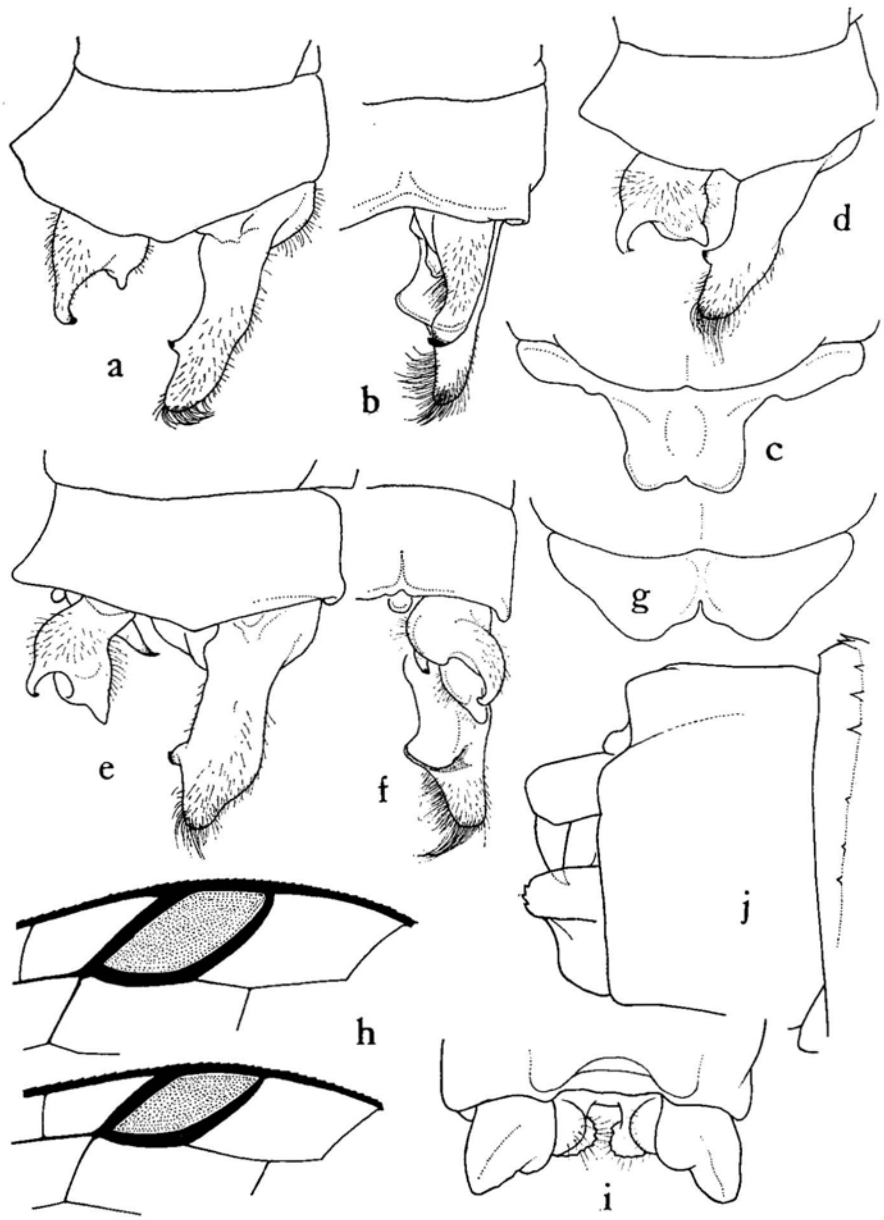


FIGURE 13.—**a-c**, *Agriocnemis femina oryzae*, Okinawa: *a*, right lateral view of male anal appendages; *b*, partial dorsal view of same; *c*, frontal view of female posterior lobe of prothorax. **d**, *A. f. femina*, Babelthuap, right lateral view of male anal appendages. **e-g**, *A. f. femina*, Luzon: *e*, right lateral view of male anal appendages; *f*, partial dorsal view of same; *g*, frontal view of female posterior lobe of prothorax. **h**, *Ischnura ezoin*, Bonin Is., pterostigmal region of male fore and hind wings. **i, j**, *I. torresiana*, southern New Guinea: *i*, dorsal view of male anal appendages; *j*, right side view of same.

yellow or green mottled with brown, and lives among aquatic growth (fig. 11, *f*).

16. Agriocnemis femina femina Brauer (fig. 13, *d-g*).

Agrion (*Ischnura*) *femina* Brauer, 1868, Zool.-bot. Ges. Wien, Abh. **18**: 554-556 ("Luzon, Basilau"; lectotype; male, Luzon).

Agriocnemis femina, Ris, 1916, Suppl. Ent. **5**: 22-26 (part), figs. 3-7 (revision).—Needham and Gyger, 1938, Philippine Jour. Sci. **70**: 278, pl. 18, figs. 265-266, pl. 21, fig. 302 (Philippines).—Lieftinck, 1949, Nova Guinea, n. ser., **5**: 261 (distrib.).

As indicated by Ris (1916, loc. cit. 22-26), this species exhibits much geographical variation, but because of the lack of sufficient material from its numerous settlements in the east, it could not at that time be split into clearly recognizable subspecies. The present examples of western Micronesian *femina* form a homogeneous series and conform closely to a number of near topotypes, collected by me in November 1953 near Manila, Luzon. Structurally, these Philippine specimens (fig. 13, *e-g*) compare very well with individuals from Mindanao, the Moluccan islands and the New Guinea region and differ only slightly from those taken in the Palau Islands and on Saipan Island (fig. 13, *d*). The robust interior spine at the base of the male superior appendix is invariably present, though only visible in profile view when the appendage is lifted (fig. 13, *d, e*). But the feature characteristic of typical *femina* is the form of this appendage, which is essentially similar in all populations examined, differing markedly from that of the Sino-Japanese subspecies mentioned below. Corresponding differences between the two are found in the posterior lobe of the female prothorax, which in specimens from the Palau and Mariana Islands is shaped as shown in figure 13, *g*.

DISTRIBUTION: From India and Ceylon to the Bismarcks and North Australia; the typical subspecies is probably from only the Philippines and Moluccas eastward; in Micronesia, S. Mariana Is., Palau Is., Yap Is.

S. MARIANA IS. SAIPAN: Several, Achugau and Papako areas, Jan. 1945, Dybas. GUAM: Female, Mt. Santa Rosa, June 1945, Bohart and Gressitt; one pair, Nimitz Beach, Aug. 1952, Krauss.

PALAU: Female, April 1936, Ono (det. J. G. Needham). BABELTHUAP: Several, Ulimang, Dec. 1947, Dybas; one pair, Iwang, east Airai, Dec. 1952, and Ngaremeskang, Dec. 1952, Gressitt; several, Ngiwal-Ngarard, Feb. 1938 and Aug. 1939, Esaki; several, Ngchesar, Ngardok Lake-Ngiwal, Aug. 1939, Esaki. KOROR: Aug., Oct. 1922, and Ngarmid, Dec. 1937, Uchiyama; several, Nov.-Dec. 1947, Dybas; Aug. 1952, Beardsley; Sept. 1952, Krauss; several, Ngarbaged, Dec. 1937, Murakami. NGURUKDABEL: Male, Ngeremediu, Dec. 1952, Gressitt. MALAKAL: Male, Sept. 1952, Krauss. NGERGOI (Garakayo): Male, Aug. 1945, Hagen. NGERKABESANG: Several, Feb. 1954, Beardsley. ANGAUR: Male, Aug. 1945, Ducoff.

YAP. YAP: Many, various localities, including Map I., July-Aug. 1950, Goss; July 1951, Gressitt; Oct.-Dec. 1952, Gressitt and Krauss; Mar.-Apr. 1954, Beardsley.

The absence of *A. femina femina* from the eastern Caroline Islands and the eastern archipelagoes is worthy of note and hard to explain. It is unfortunate that the species has not been discovered in the Bonin Islands, where it will probably prove to be represented by *A. f. oryzae* from the Ryukyu Islands.

17. Agriocnemis femina oryzae Lieftinck, n. subsp. (fig. 13, *a-c*).

Agriocnemis femina, Ris, 1916, Suppl. Ent. **5**: 25 (part), fig. 5 (Formosa).—Needham, 1930, Zool. Sinica, ser. A, **11**: 254, pl. 19, fig. 3 (Fukien); 1931, Lingnan Sci. Jour. **10**: 232 (Hainan).—Chûjô, 1931, Nat. Hist. Soc. Formosa, Trans. **21**: 36-40, figs. 17-20 (Formosa).—Okumura, 1937, Kontyû **11**: 124 (Borodino Is.).—Chûjô, 1942, Taihoku Imp. Univ., Ent. Lab. Contrib. **90**: 127 (Hainan).—Klots, 1947, Am. Mus. Nov. **1341**: 12 (Fukien).—Asahina, 1956, Nat. Sci. Mus. Tokyo, Bull. **39**: 90, pl. 20, figs. 1-3 (Ryukyu Is., larval characters); 1956, Osaka Municip. Mus. Nat. Hist., Bull. **9**: 23-24 (Ryukyu Is.).

Characters of typical *A. femina,* size equally small. *Male:* with 6-7 Px of first series in fore wing, 5 in hind wing; female 6-8 and 5-6, respectively. Abdomen of semiadult male with segments 8 to 10, anal appendages, and apical one-fourth to one-sixth of segment 7 red; adult pruinescent white as in the typical race. *Female:* dimorphic, red and green individuals represented in equal proportion. Male superior appendage is almost straight, fingerlike, its lower branch considerably smaller and shorter than upper, which is slender, straight or slightly curved (figs. 13, *a, b, d-f*); posterior lobe of female prothorax has short and narrow lateral lobes, midlobe projecting strongly in frontal view as subrectangular plate, only slightly excised (fig. 13, *c*).

Measurements: male abdomen plus appendages 15.0-16.5, hind wing 9.0-10.0 mm.; female, 16.5-19.5, 10.5-12.0 m., respectively.

Holotype, male (US 65143), and allotype (US), female, Chizuka, Okinawa I., Ryukyu Is., July 1945, Bohart and Harnage. Many paratypes, both sexes (BISHOP, ML, MCZ), all from Okinawa, May 1945, Hall; Kadena, May and Shido, June 1945, F.G.W.; Shimabuku, June 1945, Young and Parsons; Nakama, Ukama, and Yamazato, July-Aug. 1945, Field; Kaniku, Aug. 1945, Young; and Okinawa, Sept.-Oct. 1945, Field.

DISTRIBUTION:. Ryukyu Is. (*terr. typ.*), Borodino Is., east China, Formosa, Hainan.

This well-characterized Okinawan subspecies is included here because it is probably widely distributed in the northern part of the range of *A. femina.* Asahina compared specimens from Yaku Jima, Tanega Jima, and Nakano Jima (Pinnacle Island, of the Tokara group) with those collected in Formosa and found them to agree.

SUBORDER ANISOPTERA

FAMILY AESHNIDAE

KEY TO MICRONESIAN GENERA OF AESHNIDAE

1. Rs forked proximal to pterostigma, with more than two rows of cells between its branches; between Rs-Rspl and M_4-Mspl a rather uniform network of transversely arranged cells, hence no distinct supplementary sectors present; origin of M_4 in middle of Arc or slightly posterior to it, of M_{1-3} nearer M_4 than to costal (upper) end of Arc. Anal angle of hind wing rectangulate in male, forming distinct anal triangle. Auriculae present on abdominal segment 2 of male. Smaller species, hind wing not exceeding 42 mm. in length. *Larva:* Abdominal segments 6 to 9 with lateral spine; lateral appendages of anal pyramid two-thirds to three-fourths length of cerci; male epiproct elongate triangular, apex obtusely pointed..**Anaciaeschna**

   Rs forked beyond middle of pterostigma, only two rows of cells between its branches; supplementary sectors present between Rs-Rspl and M_4-Mspl following main direction of posterior branch of Rs-fork; origin of M_4 anterior to (above) middle of Arc. Anal angle of hind wing rounded in both sexes, no distinct anal triangle present. Auriculae absent on abdominal segment 2 of male. Larger species, hind wing 49-54 mm. *Larva:* Only abdominal segments 7 to 9 with lateral spine; lateral appendages of anal pyramid about half as long as cerci; male epiproct trapezoidal, apex truncated..**Anax**

Genus **Anaciaeschna** Selys

Anaciaeschna Selys, 1878, Mus. Dresden, Mitt. **3**: 317 (type: *Aeschna jaspidea* Burmeister, 1839, Handbuch Ent. **2**: 840; female, Java).

18. Anaciaeschna jaspidea (Burmeister).

Aeschna jaspidea Burmeister, 1839, Handbuch Ent. **2**: 840 (type: female, Java).

Anaciaeschna jaspidea, Asahina, 1940, Tenthredo **3** (1): 2, 21 (Saipan; Yap).—Swezey and Williams, 1942, B. P. Bishop Mus., Bull. **172**: 4 (Guam).

DISTRIBUTION: From India to the islands of the eastern Pacific (S. Mariana, Palau, and Yap Is.).

S. MARIANA IS. SAIPAN: Two males, June 1951, Bohart. GUAM: Two males, female, Pt. Oca, July 1945, Bohart and Gressitt; male, Mt. Santa Rosa, June 1945, Bohart and Gressitt.

PALAU. BABELTHUAP: Five males, female, Ulimang, "hawking above grass tops in upland grasslands at twilight; hundreds seen," and "flying at twilight, strand," Dec. 1947, Dybas. ANGAUR: Male, Dec. 1949, Owen.

YAP. YAP: Four males, female, various localities, July-Aug. 1950, Goss.

This is a migratory species with crepuscular habits which breeds in marshes and rice fields. It is easily distinguished from *Anax* by the reddish-brown thorax, the sides of which bear two broad bands of clear greenish yellow. The

appendix inferior of the male is triangular, reaching half the length of the superiors; these organs have been illustrated by Needham (1932, B. P. Bishop Mus., Bull. **113**: 22, fig. 1).

The larva of *Anaciaeschna jaspidea* is very similar to that of the Malaysian *A. montivagans* Lieftinck (fig. 14, *a*).

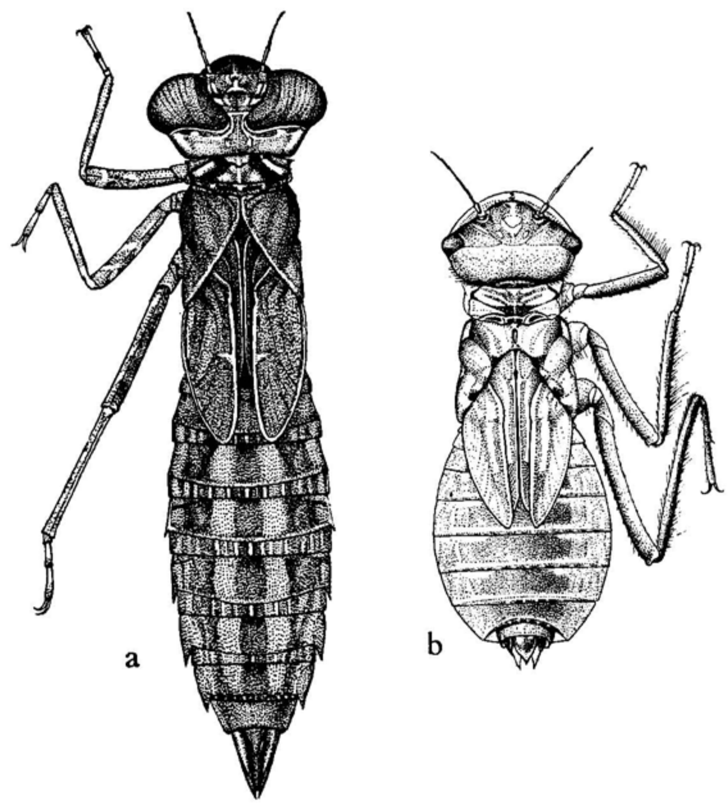


FIGURE 14.—**a**, *Anaciaeschna montivagans*, western Java: ultimate instar larva, live specimen (×3). **b**, *Hemicordulia olympica*, central northern New Guinea, ultimate instar larva (×3).

Genus **Anax** Leach

Anax Leach, 1815, IN Brewster, Edinb. Encyc. **9** (1): 137 (type: *A. imperator* Leach, ibid.; male, Europe).

This is a cosmopolitan genus which breeds in tanks, ponds, and lakes. The larvae are pelagic, living among aquatic vegetation. For a good photograph of the larva of *Anax guttatus*, see Needham (1904, U.S. Nat. Mus., Proc. **27**: 695, pl. 40, fig. 2).

KEY TO MICRONESIAN SPECIES AND SUBSPECIES OF ANAX

1. Vertical surface of frons with thick, transverse, blackish-brown band bordering crest, followed by blue stripe with faint intervening yellow line; black basal stripe also in front of vesicle of vertex. Abdomen short, equal in length to hind wing; segments 1 and 2 predominantly blue, 3 to 10 dark reddish brown marked laterally with longitudinal subinterrupted blue-green spots, confluent and band-like on 5 to 10. Appendix inferior of male very short and broad, carrying about 12 black spike-like denticles on each side above. Occipital plate of female at least slightly tuberculate posteriorly............**19. parthenope julius**

   Color of frons and abdomen not as above. Abdomen longer than hind wing. Appendix inferior of male longer, trapezoidal, carrying few teeth on each side. Occipital plate of female simple.. 2

2(1). Top of frons with broad inverted triangle of black along anterior border, disconnected from larger basal triangle of black surrounding vesicle of vertex. Hind wing lacking minute rusty brown basal spot adjacent to membranula. Segment 3 of abdomen with no lateral prejugal blue spot, basal spots of 4 to 7 small, prejugal spots linear and present only on 4 and 5. Anal appendages of female 5.0 mm. long..**21. piraticus**

   Top of frons with tiny broad basal triangle of black surrounding vesicle of vertex, but lacking anterior black triangle. Hind wing with small rusty brown basal spot adjacent to membranula. Segments 3 to 7 of abdomen with pair of roundish basal and prejugal blue spots of subequal size. Anal appendages of female 3.5-4.1 mm. long..**20. guttatus**

19. Anax parthenope julius Brauer.

Anax julius Brauer, 1865, Zool.-bot. Ges. Wien, Abh. **15**: 508 (Shanghai); 1866, Novara Exped., Zool., 1, Neuropt., 61 (key, Hong Kong), 63-66 (male, female, Shanghai; type: Shanghai).

Anax parthenope julius, Ander, 1944, Förh. K. Fysiogr. Sällsk. Lund **14**: 1-2 (distrib.).—Asahina, 1952, Mushi **23**: 45, 53 (female, Chichi Jima). —Buchholz, 1955, Bonner Zool. Beitr. **6**: 118-131, figs. 2, 8, 13 (China).

DISTRIBUTION: From the Bonins, Ryukyus, Japan, and China across southern central Asia to the Mediterranean and scattered northward to the Netherlands.

This is a widely distributed species, breeding chiefly in lakes. A number of poorly defined races are known, even the Sino-Japanese subspecies *julius* differing only slightly from some European populations of *parthenope.* The size and color are variable; topotypical males of *julius* (from Shanghai) vary much in size: abdomen plus appendages 49.0-55.0, hind wing 49.0-52.0 mm.

The female from the Bonin Islands reported by Asahina is the only specimen known from Micronesia. Apparently fairly common in the Ryukyu Islands.

20. Anax guttatus (Burmeister).

Aeschna guttata Burmeister, 1839, Handbuch Ent. 2: 840, male, female, Java (lectotype; male, Java).

Anax guttatus, Cabot, 1881, Mus. Comp. Zoöl., Mem. **8**: 16 (larva, Ebon). —Rainbow, 1897, Australian Mus., Mem. **3**: 99 (Gilbert).—Kempny,

1904, Zool.-bot. Ges. Wien, Abh. **54**: 353 (Jaluit).—Schnee, 1904, Zool. Jahrb., Syst. **20**: 404 (Jaluit).—Ris, 1916, Suppl. Ent. **5**: 63 (Palau). —Asahina, 1940, Tenthredo 3(1): 1-2, 21 (part: Woleai; Truk; Ponape; Wotje).—Lieftinck, 1942, Treubia **18**: 574-606 (revision).

Anax piraticus Kennedy, 1934, Ent. Soc. Am., Ann. **27**: 350, figs. 4-6, 19 (part; female allotype, Guam).

DISTRIBUTION: Extends from the Seychelles to North Australia, and eastward to Samoa and the Tuamotu Islands in the Pacific. Also known from the Ryukyus.

CAROLINE ATOLLS. IFALUK: Eight males, female, July-Aug. 1953, Bates.

PONAPE: PONAPE: Three males, Colonia, airfield, Nan, June-Sept. 1950, Adams; male, Colonia, Aug. 1928, Uchiyama; three females, Colonia, "at light," July 1949, Owen; male, Colonia, Jan. 1953, Clarke.

KUSAIE. KUSAIE: Male, Mutunlik, Feb. 1953, Clarke. Lele I.: July 1949, Owen.

WAKE ATOLL. WAKE: One larva penultimate, brackish water in bomb crater, Apr. 1952, Fosberg.

MARSHALL IS. KWAJALEIN: Male, Bweje I., May 1945, Wallace. ARNO: Four males, Ine I., June 1950, Usinger and La Rivers. AILINGLAPALAP: Bikajela, male, Nov. 1948, Fosberg.

GILBERT IS. ONOTOA ATOLL: Male, Tanyah I. (Buiartun), July 1951, Moul; 14 males, north Onotoa, July 1951, Moul.

The only specimen known from the Mariana Islands is the female from Guam, reported by Kennedy under *piraticus*.

21. Anax piraticus Kennedy.

Anax guttatus panybeus, Martin, 1908, Cat. Coll. Selys, 18, Aeschnines **1**: 24 (Marianas); 1911, IN Wytsman, Gen. Ins., 115, Aeschnidae, 9, (Marianas).

Anax piraticus Kennedy, 1934, Ent. Soc. Am., Ann. **27**: 346-352 (*part,* not allotype female, Guam), figs. 1-3, 7, 15 (type: male, Guam).—Schmidt, 1938, Ent. Soc. Am., Ann. **31**: 329 (catalog).—Swezey and Williams, 1949, B. P. Bishop Mus., Bull. **172**: 3-4 (Guam; notes).

Anax guttatus, Asahina, 1940, Tenthredo **3**(1): 1-2, 21 (part, Saipan).

DISTRIBUTION: S. Mariana Is. (Guam and Saipan) (endemic).

S. MARIANA IS. SAIPAN: Male, Dec. 1944, Edgar; female, July 1945, Harvey.

The present male agrees well with the description and figures of *Anax piraticus,* and the female from Saipan is no doubt also conspecific. This species runs in my key (1942, Treubia **18**: 577-587) to near *A. gibbosulus* Rambur,

to which it is closely related. Both sexes differ in that the transverse anterior portion of the T-spot on the top of the frons is very small and the stem obliterated, approaching *guttatus* in this respect. In *A. piraticus,* the abdominal segment 3 is only slightly constricted and can be further distinguished from *gibbosulus* by the absence of anterior postjugal spots on segments 4 to 7; the superior appendages of the male are very similar in the two, but even when held in a horizontal position the interomedian angulation in *piraticus* is less pronounced than it is in *gibbosulus* and the outer border of the appendage is nearly straight, not convex as in *gibbosulus.* Female *piraticus* differs from that of *gibbosulus* in having the anal appendages relatively narrower and a little shorter: male, abdomen plus appendages 70.0 mm., hind wing 53.5 mm., pt. fore wing 4.0 mm.; female, 52 plus 5.2, 54.0, 5.0 mm.

According to Asahina (*in litt.*), all specimens of *A. guttatus* recorded by him from the Mariana Islands should be referred to *A. piraticus.* Kennedy's supposed female of *piraticus* (also from Guam) quite clearly is not that species but is *guttatus,* which was not known to him at the time. *A. guttatus,* Kennedy (*nec* Burmeister) in the same paper is *A. indicus* Lieftinck (1942) and *A. gibbosulus,* Kennedy (*nec* Rambur) is probably *panybeus* Hagen.

Family CORDULIIDAE

Genus **Hemicordulia** Selys

Hemicordulia Selys, 1870, Soc. Ent. Belgique, C. R. **14**: v (type: *Cordulia australiae* Rambur, 1842, Hist. Nat. Ins. Neuropt., 146; male and female, Australia).

Slender medium-sized dragonflies with weak integument, colored metallic green, sparingly marked with yellow. Head large; thorax short, wings broad and rather pointed with open neuration; abdomen long and slim, both sexes with long slender anal appendages.

Larva of *Hemicordulia* uniform, and easily distinguished from that of most libellulid genera by the smooth convex body, broadly oval subtruncate abdomen, and absence of dorsal hooks; lateral spines on segments 8 and 9 very small, often vestigial. Labium of large size, with 5 to 8 premental and 7 to 8 palpal setae; palpus with distal border distinctly crenate. Anal pyramid very short. [Larva of central New Guinea species, *H. olympica* Lieftinck, is illustrated in figure 14, *b.*]

DISTRIBUTION: Tropical Asia, probably centered in the Papuan Region, distributed from northeast India to the Bonin Is., New Zealand, and far into the eastern Pacific, few members penetrating westward into Madagascar and adjacent island groups. Numerous species, the majority having a very restricted range.

The Micronesian species, like most of their congeners (except those inhabiting the mountains) are much alike and extremely difficult to distinguish. Males can be separated by slight differences in the genital organs, anal appendages, length of posterior femur and tibial keels; females, by the pubescence

of the occiput, length and shape of anal appendages, and wing color; both sexes in combination, by color, body size and (occasionally) venation.

The following key should be used with caution, and identifications should be checked against Asahina's figures of structural details.

Key to Micronesian Species of Hemicordulia

1. Thoracic sides with two fairly well-defined yellow bands, slightly converging above, posterior band shorter and a little narrower than anterior one. Posterior surface of female occipital tubercle beset with tuft of short stiff bristles on either side. Keel on anterior tibia of male occupying distal 6 : 10 of whole length; posterior femur of male 6.0-6.5 mm. long, reaching apex of abdominal segment 2. Anal appendages and genital organs of male and female in figure 15, *f, g*. *Male:* Abdomen (including appendages) 30.0-33.0, hind wing 27.0-28.0 mm.; *female:* 32.0+ ? and 30.0 mm., respectively. (Guam)..............**22. mindana**

   Thoracic sides metallic green, not definitely banded with yellow, or, when the ground color is yellow brown, then species is smaller. Posterior surface of female occipital tubercle often pubescent, but lacking tuft of stiff bristles laterally 2

2(1). Length of male abdomen 33.0-35.0+2.5-3.0 mm., of hind wing 31.0-33.0 mm.; female 32.0+2.5 and 36.0 mm., respectively. Body stout: thorax hairy, colored brilliant metallic coppery green without yellow markings; abdomen black with low metallic green luster. Keel on anterior tibia of male occupying distal 6 : 10 of whole length; posterior femur of male about 6.0 mm. long, reaching apex of abdominal segment 2. Superior anal appendages of male in side view gently downcurved, apices blunt. (Bonin Is.)..........**23. ogasawarensis**

   Smaller species, length of male abdomen (including appendages) not exceeding 33.0 mm., of hind wing 29.0 mm.; female 42.0 and 33.0 mm., respectively. Body more slender, thorax less hairy, unicolored metallic green or variably marked with yellow on sides and underneath.......... 3

3(2). Larger species, length of male abdomen 28.0-29.5+3.2-3.5 mm., of hind wing 27.0-29.0 mm.; female 34.5-38.0+3.5-3.7 and 30.0-33.0 mm., respectively. Slender, both sexes with very long appendages. *Adult male:* No yellow lateral thoracic markings; keel on anterior tibia occupying distal 5.5 : 10 of whole length; posterior femur 5.0-5.5 mm., not entirely reaching apex of abdominal segment 2; superior anal appendages in side view strongly undulated, with distinct interior angulation about middle of length, distal one-third finger-like, rather abruptly bent, apex blunt. *Female:* Thoracic sides partly yellow, femora light brown tipped with black, wing bases strongly tinged with golden yellow, abdomen very slender, much longer than hind wing. (Ponape)......**25. haluco**

   Smaller species, both sexes with shorter anal appendages.......... 4

4(3). Ground color of synthorax, including lower portion of dorsal surface (mesepisterna), brown; upper portion and sides broadly and confluently banded with brilliant metallic green over sutures. Posterior femur of male about 4.5 mm. long, reaching middle of abdominal segment 2. Superior anal appendages of male very slender, rather strongly downcurved in side view, apical one-third rather abruptly narrowed, after distinct angulation, undulated, with almost pointed tips. Slightly smaller: male abdomen 24.0-26.0+2.6-2.8 mm., hind wing 25.0-27.0 mm.; female 28.0-31.0+2.0-2.2 and 26.0-28.0 mm., respectively. (Palau and Yap)..........**24. lulico**

   Synthorax all dark metallic green, only posterior portion of metepimerum and ventral surface partly yellowish brown. Posterior femur of male 5.0 mm. long, reaching middle of abdominal segment 2. Superior anal appendages of male in side view almost straight in middle, apical one-third

low metallic green luster. Keel on anterior tibia of male occupying distal 6 : 10

evenly downcurved with blunt tips. Slightly larger: male abdomen 25.5-28.0+ 2.3-3.0 mm., hind wing 26.3-29.0 mm.; female 31.0-33.0+2.0 and 29.5-31.5 mm., respectively. (Kusaie)..**26. erico**

22. **Hemicordulia mindana** Needham and Gyger (fig. 15).

Hemicordulia mindana Needham and Gyger, 1937, Philippine Jour. Sci. **63**: 64-65, pl. 1, figs. 19, 20, female, male (type: female, Mindanao).

?*Hemicordulia continentalis* Martin, 1907, Cat. Coll. Selys, 17, Cordul., 13 (*pars:* Iles Mariannes).—Schmidt, 1938, Ent. Soc. Am., Ann. **31**: 331 (catalog).—Asahina, 1940, Tenthredo **3**(1): 2-3 (note).

Hemicordulia species, Swezey and Williams, 1942, B. P. Bishop Mus., Bull. **172**: 4 (Guam).

?*Hemicordulia mindana,* Asahina, 1947, Mushi **17**: 83-87, figs. 10-21 [Formosa; Ryukyus (Riu-Kiu)].

DISTRIBUTION: Guam; Mindanao; ?Ryukyu; ?Formosa.

S. MARIANA IS. GUAM: Male, two females, Umatac, May 1936, Usinger; male, Piti, May 1936, Usinger; male, Jan. 1945, Grether; male, Mt. Manell, near Merizo, May 1945, Bohart and Gressitt.

These Guam specimens compare well with a male and a female, both fully adult, from Basilan Island (south Philippines), Maloong, December 1932 and November 1931 respectively, collected by K. Kuwasima (ex coll. m., Mus. Leiden). I had identified these Philippine specimens with *Hemicordulia mindana* with some misgivings, as the description is based on a single female from Mindanao. The genital organs and anal appendages of the male are practically identical and the females agree closely in the shape and armature of the occipital triangle and the genital valvula vulvae, which are illustrated for a Basilan example in figure 15, *a-e*. Unfortunately, both females from Guam are in poor condition and lack their appendages.

In immature specimens the basal abdominal segments are predominantly yellow, whereas 3 to 9 carry distinct elongate orange-yellow streaks along the lateral tergal margins, which tend to disappear completely with age. The abdomen of the adult from segment 3 onward becomes dark metallic green, with only a fine stripe along the lateral border of 3 to 4 remaining yellow. All individuals share the characteristic feature of having two isolated, slightly divergent, yellow bands on the thoracic pleurae; one mesepimeral and one (somewhat shorter) metepisternal patch, both fairly well delimited and completely surrounded by the metallic green ground color; the lower one-third of the mesepisternum, the mesinfraepisternum and parts of the thorax ventrally are also pale-colored. Normally 7 antenodals in the fore wing and 5 in the hind wing (one Guam male has 6 in both fore wings, and one Guam female has 8 in the left fore wing).

H. mindana is closely allied with *H. tenera* Lieftinck [1930, Treubia **12**: 157-159, fig. 22 (type: male, Java); 1934, loc. cit., **14**: 431 (Java; Borneo);

1954, Handlist, Treubia, Suppl. 22: 123, 186, syn., Malaya to Borneo]. The genital organs of this species are nearly identical with those of *mindana,* as is the occiput of the female. However, I prefer to keep the two species separate because of the following differences: (1) yellow lateral thoracic markings of *tenera* less bright but more extensive, ill-limited and intermingled with metallic green luster, broadly confluent across the first lateral suture; posterior portion of metepimerum less deeply metallic; (2) posterior femur (excluding tro-

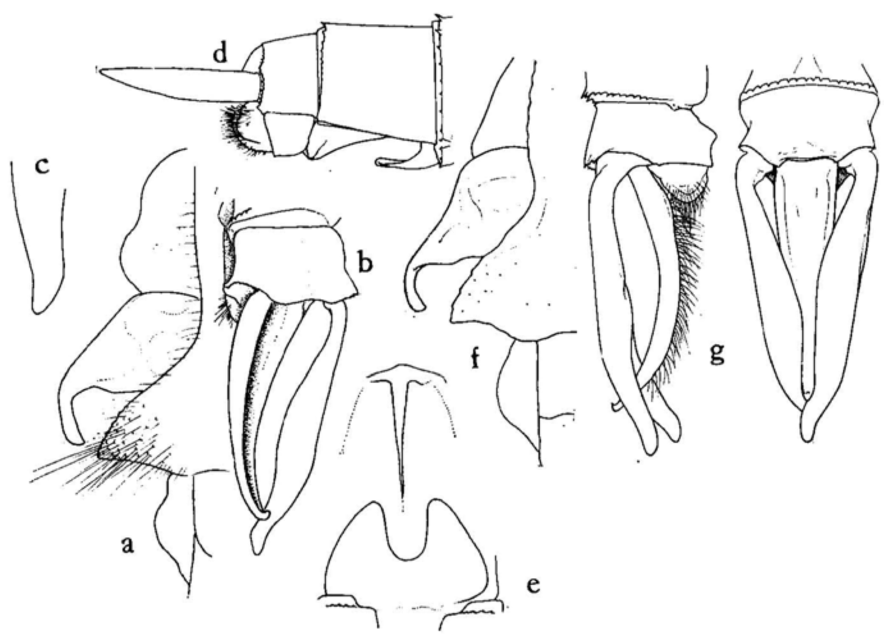


FIGURE 15.—a-e, *Hemicordulia mindana,* Basilan I.: *a,* male genitalia, left side; *b,* male anal appendages, dorsolateral view; *c,* apex of right superior appendage, exterior view, more enlarged; *d,* apex of female abdomen, right side; *e,* valvula vulvae and ninth sternal plate of female. f, g, *H. mindana,* Guam: *f,* male genitalia, left side; *g,* male anal appendages, right side and dorsal views.

chanters) of male longer, 7.0-7.5 mm.; and (3) anal appendages of female 2.5-2.7 mm., longer than segments 9 and 10 together (in *mindana* from Basilan, distinctly shorter; Guam, unknown).

The examples of supposed *mindana* from the Ryukyus and Formosa, described and illustrated by Asahina (1947, Mushi 17: 83-87), are considerably larger than those from Mindanao and Guam discussed above. Judging from the figures, the Isigaki and Formosa specimens appear closest to topotypical *mindana* (or, more likely, to *tenera*), but Asahina's series from Nakano Jima might belong to yet another species of this difficult genus.

Table 2.—Comparison of Hemicordulia

Species	Locality	Measurements (in mm.)		
		Abdomen incl. Appendages	Hind Wing	Femur 3
Hemicordulia mindana				
Males	Basilan	33.0	29.0	6.5
	Guam	30.0	27.0	6.5
	Guam	31.0	27.0	6.0
	Guam	32.0	28.0	6.3
	Guam	33.0	28.0	6.4
Females	Basilan	32.5 + 2.1	31.0	
	Guam	32.0 +	30.0	
Hemicordulia tenera				
Males	Java (type)	34.5	29.0	7.0
	Java	34.0	30.0	7.5
	Malaya	32.5	28.5	7.0
	Sumatra	32.5	28.0	7.0
	Sumatra	32.5	29.0	7.0
	Sumatra	33.0	30.0	7.0
	Sumatra	33.0	30.0	7.0
	Borneo	32.5	28.0	7.0
	Borneo	32.5	28.0	7.0
	Borneo	33.0	29.0	7.0
	Borneo	33.0	30.0	7.0
	Borneo	34.0	30.0	7.5
	Borneo	34.5	30.0	7.5
	Borneo	37.0	30.0	7.4
Females	Sumatra	31.6 + 2.4	29.0	6.7
	Sumatra	32.0 + 2.5	29.5	6.5
	Borneo	32.6 + 2.4	29.5	6.5
	Borneo	35.4 + 2.7	31.5	7.0

I have seen the type of *H. continentalis* Martin from New South Wales in the Paris Museum. It was doubtfully recorded from the Mariana Islands by Martin, but it is a different species.

23. Hemicordulia ogasawarensis Oguma.

Hemicordulia ogasawarensis Oguma, 1913, Zool. Mag., Tokyo **25**: 443 (male, Ogasawara-zima); 1915, Ent. Mag. Kyoto **1**: 13; 1922, Deutsche Ent. Zeitschr., 103-104, 111 (male, Bonin Is.).—Esaki, 1930, Biogeogr. Soc. Japan, Bull. **1**: 209 (list).—Okumura, 1932, Kontyû **6**: 72-73 (female, Chichi Jima).—Asahina, 1947, Mushi **17**: 81-83, figs. 4-9 (Chichi Jima, Haha Jima); 1952, Mushi **23**: 45-46, 56 (Chichi Jima, Haha Jima).

DISTRIBUTION: Bonin Islands (endemic).

BONIN IS. Chichi Jima: Male, Omura Yama, July 10, 1949, Mead.

24. Hemicordulia lulico Asahina.

Hemicordulia lulico Asahina, 1940, Tenthredo **3**(1): 5-8, 21, text figs. 7-12, pl. 1, figs. 3, 4 (Babelthuap and Yap; type: male, Yap).

DISTRIBUTION: Palau and Yap (endemic).

PALAU. Babelthuap: Male, Apr.-May 1949, Langford.

YAP. Map: Male (paratype; KU), Nov. 11, 1939, Esaki.

25. Hemicordulia haluco Asahina.

Hemicordulia haluco Asahina, 1940, Tenthredo **3**(1): 3-5, 21, text figs. 1-6, pl. 1, figs. 1, 2 (male, female, Ponape; type: male, Ponape).

DISTRIBUTION: Ponape (endemic).

PONAPE. Male (paratype; KU), Ponape, Rohnkiti-Palikir, Jan. 1938, Esaki; male, Colonia, trail, secondary forest, Feb. 1948, Dybas; male, Colonia, July 1949, Owen; six males, female, Colonia and Mt. Dolen Net, peak Tulenkuip, 200 m., also from higher altitudes, marked 240 m. and 420 m., June-Sept. 1950, Adams; male, Mt. Temwetemwensekir slope, about 150-300 m., Feb. 1948, Dybas; female, Nanpohnmal, Jan. 1953, Clarke.

26. Hemicordulia erico Asahina.

Hemicordulia erico Asahina, 1940, Tenthredo **3**(1): 8-10, 21, text figs. 13-18, pl. 2, figs. 5, 6 (Kusaie; type: male, Kusaie).

DISTRIBUTION: Kusaie (endemic).

KUSAIE. Male (paratype; KU), Mwot-Utwe, Nov. 8, 1939, Esaki; male, July 1949, Owen; male, female (in copulation), Funaunpes, Feb. 1953, Clarke; male, Mt. Matante, Feb. 1953, Clarke; two males, Innem R., 60 m., Feb. 1953, Clarke; male, Malem, Mar. 1953, Clarke; male, Mt. Wakapp, 55 m., Apr. 1953, Clarke.

Family Libellulidae

Key to Micronesian Genera of Libellulidae

1. Last antenodal nervure of second series in fore wing nearly always present, i.e., distal Ax complete 2
   Last antenodal nervure of second series in fore wing absent, i.e., distal Ax incomplete. Arculus between Ax_1 and Ax_2. Proximal side of hind wing triangle at or a little proximal to level of Arc 6

2(1). Arculus between Ax_1 and Ax_2. Neuration open. Only six to seven Ax in fore wing and five in hind wing. Discoidal field of fore wing strongly expanded toward wing margin, with two rows of cells. Sectors of Arc in fore wing separated at their origin, in hind wing shortly stalked. Proximal side of hind wing t at or slightly before level of Arc. Cubital space with a single cross vein. All t and ht free; ti of fore wing two- to three-celled. Rspl and Mspl both subtending a single row of cells; only a single cross vein; anal loop of hind wing closed, foot-shaped, but hardly extending beyond apex of triangle. Head large, medium eyeline longer than occipital triangle. Posterior lobe of prothorax small, naked. Body

golden brown, marked with brown and black; abdomen depressed, tapered, mainly yellowish red. Size moderate, hind wing 30 mm.................**Macrodiplax**

Arculus at or distal to Ax_2. At least 10 Ax in fore wing and eight in hind wing; venation more complex.. 3

3(2). Posterior lobe of prothorax either small and rounded or conspicuous and more or less bilobate, but always erect or suberect and fringed with long hairs. Proximal side of hind wing t at level of Arc.................................... 4

Posterior lobe of prothorax small, without conspicuous hair fringe. Rspl and Mspl distinct, at least so in hind wing, almost straight, both subtending a single row of cells. Frons and vertex brilliant metallic, latter bituberculate. Abdomen predominantly scarlet.................................... 5

4(3). Discoidal field of fore wing almost parallel-sided, with only two rows of cells up to level of bridge; Cu_1 and Cu_2 in fore wing only slightly anteriorly convex, Cu_1 in hind wing at anal angle of t; t of fore wing with costal side more than half as long as proximal side, only occasionally traversed; ti free or traversed once; t of hind wing with one cross vein; ht in fore and hind wing free; cu in fore wing with one, in hind wing with two cross veins; M_2 not undulated; one row of cells Rs-Rspl; one to two bridge cross veins; anal loop of hind wing foot-shaped, extending slightly beyond level of distal angle of t. Frons and vertex brilliant metallic, the latter not distinctly bituberculate; posterior lobe of prothorax small, rounded; thorax yellow and black; basal abdominal segments partly red. Small, slenderly built species, hind wing 20.0-25.5 mm. ....**Pacificothemis**

Discoidal field of fore wing strongly dilated toward wing border, with three rows of cells; Cu_1 and Cu_2 in fore wing strongly anteriorly convex, Cu_1 in hind wing arising from distal side of t; t of fore wing very narrow, with costal side less than half length of proximal side, traversed once; ti three-celled; t of hind wing free; ht in fore wing with a cross vein, in hind wing free; cu in fore and hind wing with a single cross vein; M_2 distinctly undulated; two rows of cells Rs-Rspl; only one bridge cross vein; anal loop of hind wing foot-shaped, extending well beyond level of distal angle of t. Frons and vertex not metallic; posterior lobe of prothorax conspicuous, slightly notched apically; body greenish yellow, marked with black. Larger species with basal segments of abdomen markedly swollen, hind wing 33-35 mm....................................**Orthetrum**

5(3). Wings long and narrow, basal portion of hind wing not much broader than that of fore wing and posterior border not strongly convex. Anal loop of hind wing closed, elongate, but of small size and blunt, not distinctly foot-shaped and not extending beyond level of distal angle of t; proximal side of hind wing t well distal to level of Arc, the triangle itself free or traversed once; Arc well distal to Ax_2; discoidal field of fore wing commencing with two to three cells followed by two cell rows, almost parallel-sided up to level of bridge, thereafter expanded; t of fore wing variable in shape, free or with one cross vein, its costal side occasionally slightly fractured; ti free or two- to three-celled; all ht free; cu with one cross vein in fore wing, one to three in hind wing; only one bridge cross vein. Size small to moderate, abdomen but little shorter than hind wing, that of male slender and somewhat spindle-shaped, hind wing 23-30 mm. ....**Agrionoptera**

Wings shaped as in figure 18, *b*; posterior border of hind wing more convex, anal loop foot-shaped, with heel of narrowed toe extending beyond level of distal angle of t. Venation somewhat variable: occasionally proximal side of hind wing t slightly distal to Arc and Arc a little distal to Ax_2; discoidal field of fore wing hardly expanded toward margin; t of fore wing with one to two cross veins, its distal side slightly con-

vein; M_2 distinctly undulated; two rows of cells Rs-Rspl; only one bridge

cave; ti two- to three-celled; all ht traversed once; cu with three cross veins in fore and hind wing; two or three bridge cross veins; Ax 14-15 in fore wing, 10-11 in hind wing. Size moderate, abdomen of male broader, triquetral in cross section, gradually tapered from base to apex, hind wing 30-31 mm. .... **Lyriothemis**

6(1). Small species, hind wing 20-24 mm., with short and relatively broad wings and slender, spindle-shaped abdomen. Posterior lobe of prothorax well developed, margin fringed with long hair. Fore wing with not more than 8.5 Ax; discoidal field commencing with two to three cells followed by two cell rows but expanding strongly toward wing margin; Cu_1 in hind wing arising from distal side of t; sectors of Arc fused at origin; proximal side of hind wing t at Arc; cu of fore wing with one, of hind wing with one to two cross veins; t of fore wing free or traversed once, of hind wing free; ht free; ti three-celled; only one bridge cross vein; Rspl and Mspl short but distinct, both subtending a single row of cells; anal loop of hind wing closed, distinctly foot-shaped; anal field broad but with only three cell rows between A_2 and margin .... **Diplacodes**

Larger species, hind wing at least 25 mm. Posterior lobe of prothorax small, lacking long hair fringe. Fore wing with at least 9.5 Ax; Cu_1 in hind wing at anal angle of t 7

7(6). Wings of male and of isochromatic female dark reddish brown from base to proximal side or middle of pterostigma, colored area squarely truncated in male, less sharply defined in female; wings of heterochromatic female at least with apices obscured; with very dense secondary reticulation, especially in male; cu with three to six cross veins in fore wing, two in hind wing; t with two to many cross veins in fore wing, one to two in hind wing; ti of fore wing well defined, comprising six to many cells, two to three bridge cross veins in fore wing, two in hind wing; 14.5-16.5 Ax in fore wing, 12-14 in hind wing; discoidal field of fore wing parallel-sided and very slightly expanded at wing margin, with three to six cell rows; Arc occasionally at Ax_2 in hind wing; pterostigma 3-3.5 mm. Male genitalia not very prominent; female vulvar scale projecting ventrad, subtriangular; anal appendages of both sexes short .... **Neurothemis**

Wings particolored or hyaline, but not as described before; reticulation generally less dense; cu with one cross vein in fore wing, one to two in hind wing; t of hind wing free; ti of fore wing either well defined with three cross veins, or irregular and made up of more cells; only a single bridge cross vein; 9.5-14.5 Ax in fore wing, 7-8 in hind wing; discoidal field of fore wing parallel-sided or narrowed toward wing margin. Head large with long median eyeline (except *Rhyothemis*) 8

8(7). Veins A_1-A_2 inclosing anal loop of hind wing running on to meet posterior margin of wing, or at least not meeting each other apically, that is, apex of anal loop open; ti of fore wing often more or less quadrangular but fairly well defined, made up of three cells; discoidal field of fore wing with three rows of cells, its sides converging at wing margin. M_2 and Rs slightly undulated. Anal appendages relatively long in both sexes. Crepuscular species 9

Veins A_1-A_2 enclosing anal loop of hind wing, converging and meeting each other just before posterior margin of wing, that is, apex of anal loop closed; ti of fore wing irregular in shape and not clearly defined, made up of more than three cells; anal field of hind wing very broad, cells arranged in transverse rows 10

9(8). Abdomen longer than hind wing; basal segments strongly inflated, remainder slim and parallel-sided. Rspl and Mspl both subtending single row of cells; costal side of t in fore wing at least half length of proximal

tion, especially in male; cu with three to six cross veins in fore wing,

side. Wing membrane often diffusely tinged with yellowish brown; hind wing usually with small dark-brown basal spot. Vulvar scale of female long, deeply bifid; ninth sternal plate curved ventrad, clothed with bristles .... **Zyxomma**

Abdomen shorter than hind wing, broad at base, then tapering gradually to the end. Rspl subtending two rows, Mspl single row of cells; costal side of t in fore wing less than half length of proximal side. Wing membrane clear, yellowish at base, but hind wing in both sexes usually with diffuse cloudy brown patch between Arc and nodus and male with opalescent, milky white, central area bordering brown spot. Vulvar scale of female short, completely divided into two small triangular lobes; ninth sternal plate conspicuous, tongue-shaped .... **Tholymis**

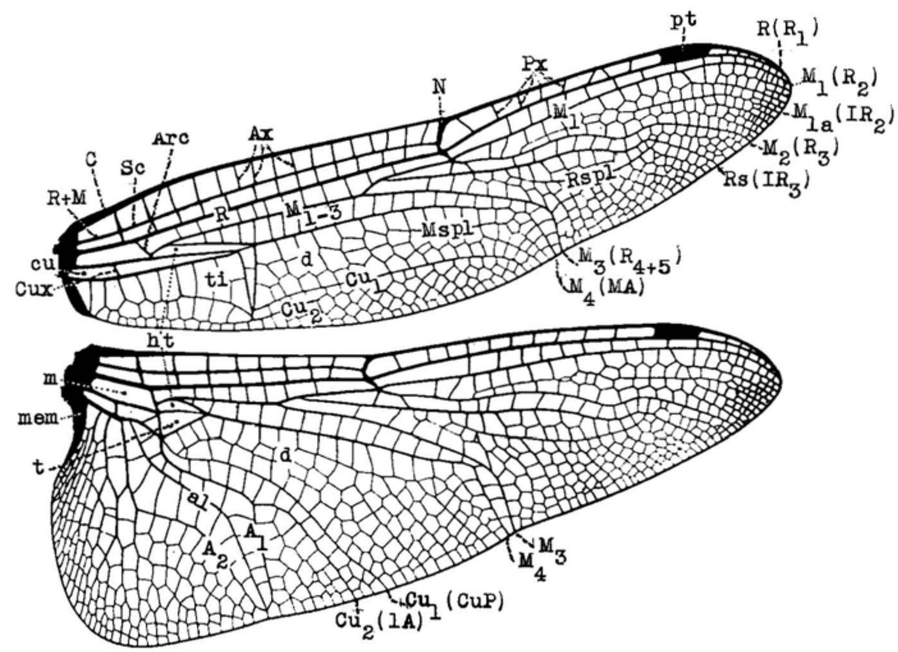


FIGURE 16.—*Pantala flavescens*, wings. Alphabetical lettering of revised Needham-Tillyard notation, used in this paper, followed by that of bracketed new notation of Lameere-Tillyard. Veins denoted by capitals, spaces and areas by small letters; x stands for cross vein. Wing photograph after Needham and Westfall, 1955. Abbreviations: al = anal loop; Arc = arculus; Ax = antenodal cross vein; A_1, A_2 = first and second branch of analis; Bx = bridge space, bridge cross vein; C, c = costa, costal space; cu, Cux = cubital space, cubital cross vein; Cu_1, Cu_2 = first (upper) and second (lower) branch of cubitus; CuP = cubitus posticus; d = discoidal field; ht = hypertriangle or supratriangle; IR_2, IR_3 = intercalated branches of radius; m = median space; MA = anterior median; M_{1-3}, M_4 = main stem and distal to proximal branches of media; M_{1a} = postnodal sector; Mspl = median supplement; mem = membranula; N = nodus; pt = pterostigma; Px = postnodal cross veins; R = radius; R + M = fused radius and media; R_{1-5} = branches of radius; Rs = radial sector; Rspl = radial supplement; Sc = subcosta; t = discoidal triangle; ti = internal triangle or subtriangle; 1A = first anal.

10(8). Body almost wholly black with dark metallic green or blue shine. Wings broadly and handsomely colored with brown and (or) yellow, often with slight metallic reflections; sectors of Arc separated at origin in fore wing, shortly fused in hind wing; ht of fore wing with two cross veins, in hind free; t in fore wing with two to three cross veins, in hind wing free; discoidal field of fore wing with four to five rows of cells; M_2 and Rs almost straight; two to three rows of cells between Rs-Rspl, two rows between M_4-Mspl; 10.5 Ax in fore wing, 7 in hind wing; pterostigma subequal in length in fore and hind wing. Vulvar scale and anal appendages of female short........**Rhyothemis**

Body yellowish brown, or red marked with black, only dorsal surface of frons sometimes metallic blue or purple. Wings not conspicuously colored, except in *Tramea* the hind pair at base; sectors of Arc fused at origin; ht free in all wings; two rows of cells between Rs-Rspl; pterostigma of fore wing small, but longer than that of hind wing. Anal appendages of female long and straight, acute........11

11(10). Hind wing with opaque, reddish-brown coloring at base. Discoidal field of fore wing not distinctly narrowed at wing border; M_2 and Rs nearly straight, but distal portion of both veins strongly curved toward wing border; Mspl subtending two cell-rows in fore wing, one in hind wing; heel of anal loop almost rectangulate; discoidal field of fore wing with four to five rows of cells; cu of hind wing with a single cross vein; 10.5-11.5 Ax in fore wing, 7 in hind wing. Body rather dark brown, but abdomen of male predominantly red, marked with black on terminal segments. Vulvar scale of female prolonged, deeply divided into two oval or elongate lobes........**Tramea**

Hind wing at most yellowish at base. Wings, figure 16. Discoidal field of fore wing distinctly narrowed at wing border; M_2 and Rs both strongly undulated, M_2 meeting wing margin under acute angle, end of Rs dissolved; Mspl subtending single row of cells in all wings; heel of anal loop obtuse-angulate; discoidal field of fore wing with three to four rows of cells; cu of hind wing with 2 cross veins; 13.5-14.5 Ax in fore wing, 7 in hind wing. Body predominantly yellowish brown, sparingly marked with black. Vulvar scale of female vestigial........**Pantala**

Key to Known Larvae of Micronesian Libellulidae

1. Head squarish, concave between small knoblike eyes, situated far forward and prominently elevated anterolaterally; sides behind eyes nearly straight and parallel. Body long, legs hairy, abdomen triquetral, sides subparallel, apex pointed (fig. 23, *b*). Dorsal hooks present on abdominal segments 4 to 7, long, straight, acute, increasingly more declined apically, tooth on 4 erect; lateral spines present on segments 8 and 9, slightly incurved, acute; anal pyramid long and slender. Labium with three primary premental setae on each side and with eight palpal setae; palpus with opposed distal margins distinctly crenate; movable hook small. Length 17-19 mm........**Orthetrum sabina**

Head trapezoidal or rather pentagonal, sides sloping from laterally prominent eyes, frons and vertex flat or convex. Body wider, more or less oval in outline, less hairy. Remaining characters combined not as above........2

2(1). Dorsal hooks present on middle abdominal segments........3

No dorsal hooks on abdominal segments........7

ments. Vulvar scale of female prolonged, deeply divided into two oval

3(2). Eyes relatively small, projecting anterolaterad; sides of head subparallel behind eyes, then rather suddenly narrowed about midway length of head; occipital lobes and thoracic prominences fringed with coarse scurfy hairs. Dorsal hooks present on segments 3 to 9, strong, suberect, and spinelike, not strongly curved, longest on 7 to 9; lateral spines present on 8 to 9, both strong, slightly incurved, longest on 9. Labium with three primary premental setae and several secondaries on each side, and with four palpal setae; palpus with opposed distal margins crenate. Length of body 16.5 mm...**Lyriothemis insularis**

Eyes larger or, when small, situated farther back and projecting more distinctly laterad; head strongly narrowed behind eyes. Dorsal hooks on segments 6 to 9 long and laterally flattened... 4

4(3). Dorsal hooks present on segments 3 to 8 (absent on 9), forming high-arched ridge on middle segments, where they are laterally flattened but little longer than high; no continuous line of decurvature posteriorly by absence of ridges on segments 9 and 10 and appendages. Lateral spines of segments 8 and 9 strong, sharply acute, those of 9 surpassing appendages in lateral view. Head large with conspicuously prominent eyes. Labium with seven to nine primary premental setae and several secondaries on each side, and with seven to eight palpal setae; palpus with opposed distal margins shallowly crenate. Length of body 19-22 mm.....................
....**Macrodiplax cora**

Dorsal hooks present on segments 3 to 9, or 4 to 9, forming low or arched ridge on middle segments; line of decurvature continued by ridge on segment 10 and/or epiproct. Lateral spine on segment 9 not surpassing anal appendages. Head smaller.. 5

5(4). Wing buds very long, reaching apex of abdominal segment 7 or beyond; body more depressed, segments 8 and 9 broad, lateral spines of these segments relatively small, subequally long, sharply acute; segment 10 almost fully retracted; dorsal hooks present on segments 3 to 9, forming low ridge on middle segments, where they are laterally flattened and little longer than high. Labium with 11 primary premental setae each side, gradually decreasing in length inwardly, and with six palpal setae; palpus with opposed distal margins distinctly crenate. Length of body 11-13 mm...**Rhyothemis phyllis**

Wing buds much shorter, extending at most to slightly beyond posterior border of segment 6; body higher, triquetral; segment 10 annular but well visible, median carina ending in short obtuse hook; dorsal hooks on segment 6 to 9 lower, declined, much longer than high and with long, straight upper margin.. 6

6(5). Anal pyramid shorter than segments 9 plus 10; epiproct triangular, carinate, shorter than cerci, its upper margin distinctly convex in lateral view; superior appendages half as long as cerci. Eyes moderate, sides of head behind eyes less strongly convergent. Abdomen triquetral but with dorsal surface slightly convex, oval in outline, apex subtruncate. Lateral spines of segments 8 and 9 prominent, with axes directed straight to rearward. Dorsal hooks on segments 4 and 5 slender and erect, those on succeeding segments much longer and declined. Labium with 10 premental setae each side, the two to three inner- and outermost setae rapidly decreasing in length, the fifth and sixth longest: palpus with eight setae and very slender, rather short, movable hook, opposed distal margins distinctly crenate, but the eight crenations much broader than deep, the first divided, and each bearing two to three spiniform setae. Body 15-17 mm.................
....**Zyxomma petiolatum**

Anal pyramid longer than segments 9 plus 10, forming together an attenuated point; epiproct straight and spine-like, sharply triquetral, equal

low ridge on middle segments, where they are laterally flattened and

in length to cerci, upper margin straight in lateral view; superior appendages only one-third length of cerci. Eyes smaller and more prominent, covering lateral angles of head, sides of head behind eyes strongly convergent. Abdomen triquetral, sharply edged and with flat sides sloping like low roof, oval in outline but apical segments rapidly diminishing in width and tapering to a point. Lateral spines of segments 8 and 9 short, straight and acute, but not very prominent, with apices directed inward, those of 9 as long as segment 10. Dorsal hooks on segment 3 to 5 slender and erect, those on succeeding segments much longer and declined. Labium with five to six primary premental setae and two to four secondaries on each side, and with five palpal setae; palpus with opposed distal margins crenate. Body 18-19 mm..................... **Tholymis tillarga**

7(2). Small species, body not exceeding 12 mm., in length. Lower margin of segment 9 of abdomen fringed with longish hairs.. 8

Larger, body at least 14 mm. long.. 9

8(7). Greatest width of abdomen about midway its length. Facies and color pattern, see figure 26, *b*. Labium with 12 to 13 premental setae each side (nine to 10 primaries), and 10 to 11 palpal setae; palpus with opposed distal margins almost entire, faintly crenate, obsolete crenations represented by single spiniform seta.. **Diplacodes trivialis**

Greatest width of abdomen slightly beyond halfway its length. Facies and color pattern, see figure 26, *a*. Labium with 12 premental setae each side (10 primaries), and 10 palpal setae; palpus much as in *trivialis*........ .... **Diplacodes bipunctata**

9(7). Lateral spines of segments 8 and 9 of abdomen and anal pyramid short. Smaller species, body not exceeding 15 mm. in length.. 10

Lateral spines of segments 8 and 9 of abdomen and appendages of anal pyramid quite conspicuous, long and acuminate. Large species, body at least 21 mm. long.. 11

10(9). Labium with 12 to 14 premental setae each side, gradually decreasing in length inwardly, and with 12 to 13 palpal setae; palpus with opposed distal margins crenate, each crenation bearing tuft of spiniform setae, first crenation divided (see fig. 25, *a*, *b*). Eyes relatively small. Middorsal ridge of abdomen not lighter colored than rest of abdomen; apices of wing buds obscured. Superior anal appendages about two-thirds length of epiproct, which is almost as long as the cerci. Length of body 14 mm..... .... **Agrionoptera sanguinolenta**

Labium with 11 to 13 premental setae each side, gradually decreasing in length inwardly, and with eight to nine palpal setae; palpus with opposed distal margins almost entire, very slightly undulated, obsolete teeth represented by single spiniform setae (fig. 25 *c*, *d*). Eyes relatively large. Middorsal ridge of abdomen pale-colored; apices of wing buds not darker than rest of wings. Superior anal appendages about one-fifth shorter than epiproct, which is almost as long as the cerci. Length of body 14-15 mm... **Neurothemis** spp.

11(9). Epiproct of anal pyramid longer than cerci, abruptly narrowed at one-third its length from base and terminating in slender spine. Lateral spines of segment 9 longer and more strongly incurved than those of 8. Labium with 15 to 18 premental setae each side (12 to 13 primaries), and 10 to 14 palpal setae; palpus with opposed distal margins strongly serrate, with eight to nine deeply incised crenations, each armed with one to three spiniform setae. Head small and not very broad, eyes not protuberant. No hair comb on anterior and middle pair of tibiae; middle and posterior tarsi black. Body 24-25 mm. long............................ **Pantala flavescens**

Epiproct and anal pyramid distinctly shorter than cerci, abruptly narrowed about halfway its length and terminating in spine. Lateral spines of

segments 8 and 9 subequal in length, both slightly incurved. Labium with 11 to 12 premental setae on each side (seven to eight primaries), and 10 to 11 palpal setae; palpus with opposed distal margins feebly serrate, with about 11 low crenations, each armed with four to five spiniform setae. Head larger and wider, eyes more protuberant. Anterior and middle tibiae with dense comb of bristlelike hairs; tarsi not black. Body length 24-27 mm. long..**Tramea transmarina**

Genus **Pacificothemis** Asahina

Pacificothemis Asahina, 1940, Tenthredo **3** (1) : 10-11, text figs. 19-23, pl. 3, figs. 9, 10 (type: *P. esakii* Asahina, ibid., male, Ponape).

This genus may be endemic in Ponape. It seems to find its place in Ris' subgroups II.2 or II.3 (comprising the Old World genera *Pornothemis, Amphithemis, Epithemis, Lyriothemis,* and *Diplacina*), but it is quite distinct from all of them. The stature and scheme of coloration are reminiscent of the Indian *Epithemis mariae* (Laidlaw), but the venation is very different. *Pacificothemis* somewhat resembles the Philippine species group of *Diplacina nana* Brauer, in which abdominal segment 3 of the male is partly red; but here again, there are many differences.

27. Pacificothemis esakii Asahina (fig. 17).

Pacificothemis esakii Asahina, 1940, Tenthredo **3** (1) : 10-11, text figs. 19-23, pl. 3, figs. 9-10.

Male: Median lobe of labium obscured, opposed margins of lateral lobes narrowly black; labium and labrum cadmium yellow, clypeus and anterior portion of frons light green. Ground color of thorax light green; markings deep black, not metallic. Legs black; trochanters of all legs and inner surfaces of first and second femora yellow, posterior femur black; tarsal claws with distinct inferior tooth at some distance from apex. Wings clear, pterostigma light brown. Fore wing with 10-11 Ax and 7-8 Px; hind wing with 8-9 Ax and 6-8 Px. Arc at Ax_2 (six wings) or slightly distal to it (one fore and one hind wing); t of fore one hind wing free (traversed once in one fore wing), t in hind wing at level of Arc; Cu_1 in hind wing at anal angle of it. Abdomen black, marked with green and blood red, as follows: basal half of segment 1 black, distal half green; dorsum of 2 dark brown, sides green; basal two-fifths of 3 blood red, remainder deep black and tergal area below lateral carina green; 4-10 and anal appendages black, 4-8 each with minute blood-red, basal, middorsal spot gradually increasing in size to rearward, largest and roundish on 8, on which it occupies about one-fifth of dorsum.

Measurements: Abdomen plus appendages 23.0 mm., hind wing 24.0-25.0 mm., pterostigma 2.0 mm.

Female: Unknown.

The original description is based upon a single, immature male. The present examples are adult and show the above differences.

DISTRIBUTION: East Caroline Is. (Ponape; endemic).

PONAPE. Three males, Colonia, June-Sept. 1950, Adams.

The median position of the red spots on the abdominal segments of the male is a unique and possibly primitive feature of *Pacificothemis*, suggesting affinities with the Tetrathemistinae.

black; labium and labrum cadmium yellow, clypeus and anterior portion of frons light

Genus **Lyriothemis** Brauer

Lyriothemis Brauer, 1868, Zool.-bot. Ges. Wien, Verh. **18**: 180-181, 365 (key), 728 (type: *L. cleis* Brauer, ibid., male, Mindanao).—Ris, 1909, Cat. Coll. Selys, 9, Lib. **1**: 20 (key), 100-120, figs.

Neothemis Oguma, 1922, Deutsche Ent. Zeitschr., 102, figs. (type: *N. insularis* Oguma IN Matsumura, 1913, op. cit. *postea,* male, Bonin Is.).—Cowley, 1934, Ent. Month. Mag. **70**: 245 (note; name preoccupied).

Boninthemis Asahina, 1952, Mushi **23**: 46-47, figs. [type: *Neothemis insularis* (Oguma), Ogasawara-zima; n. syn.].

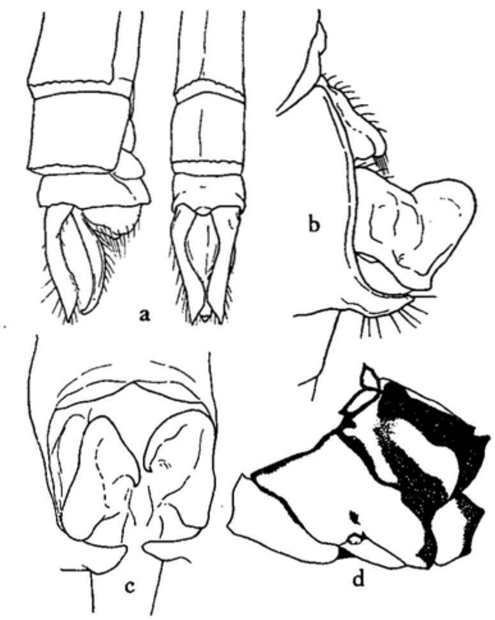


FIGURE 17.—*Pacificothemis esakii,* Ponape: **a,** male anal appendages; **b,** genitalia, right side; **c,** genitalia, ventral view; **d,** color pattern of synthorax, oblique dorsolateral view. (After Asahina, 1940.)

This is an Asiatic genus of wide distribution, extending from northeast India to Japan and throughout southeast Asia as far as New Guinea. Several species breed in leaf-bottomed pools and various water-holding receptacles in the forest. Specific characters are quite diversified and curiously mixed; moreover, most species are highly variable.

28. Lyriothemis insularis (Oguma). (Figure 18.)

Neothemis insularis Oguma, IN Matsumura, 1913, Thousand Ins. Japan, Add. **1**: 53 (Japanese descr.; Ogasawara-zima).—Oguma, 1915, Ent.

Mag. Kyoto **1**: 11 (list); 1922, Deutsche Ent. Zeitschr., 102-103, 110, pl. 2, figs. 8-11 (Bonin Is.).—Esaki, 1930, Biogeogr. Soc. Japan, Bull. **1**: 209 (list).—Oguma, 1932, Icon. Insect. Japon., 1927 (Ogasawara-zima).

Boninthemis insularis, Asahina, 1952, Mushi **23**: 46-48, 56 (Chichi Jima, Haha Jima); 1958, Shin Konchū **11**: 52 (Bonin Is., larval characters).

DISTRIBUTION: Bonin Is. (endemic).

BONIN IS. HAHA JIMA: Two males, July 1951, Bohart.

The only regional species is endemic in the Bonin Islands. It falls in Ris' group A and approaches *Lyriothemis meyeri* Selys (New Guinea) in general appearance and in the number of Cux in fore wing; it is also similar to *hirundo* Ris (New Guinea), but *insularis* differs from both in the longer and more angulated anal loop, in the denser venation, and in the male genitalia, which

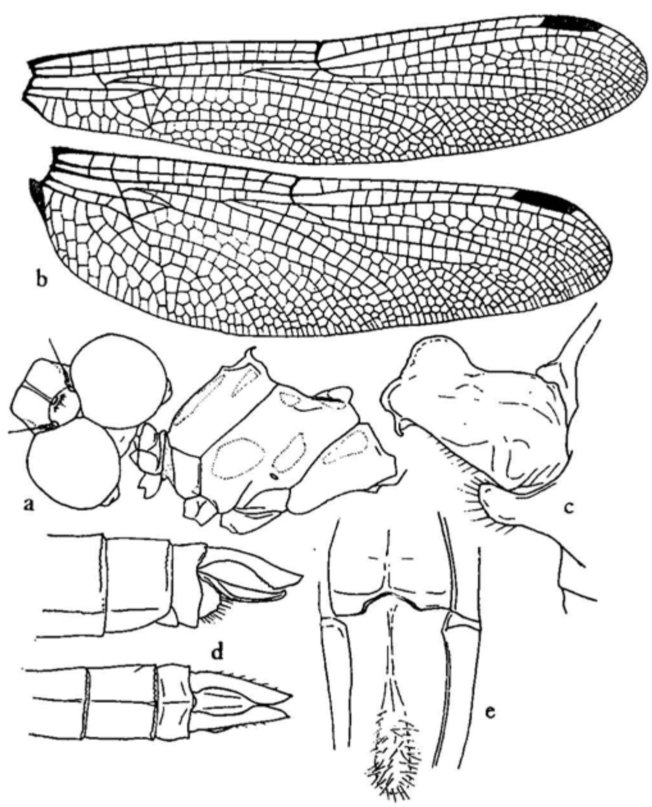


FIGURE 18.—*Lyriothemis insularis,* Bonin Is.: **a,** head and thorax of male; **b,** wings; **c,** genitalia; **d,** anal appendages; **e,** valvula vulvae and ninth sternal plate of female. (After Asahina, 1952.)

resemble most closely those of the genotype, *L. cleis* Brauer. The anal loop is shaped much as in *cleis, eurydice* Ris, and *salva* Ris; but all of these species have broader hind wings. Geographically its nearest neighbor, *L. elegantissima* Selys (Ryukyus and China), is also a red-bodied insect and is of equal size; but *insularis* has narrower wings, a better developed anal loop and more cross veins in cu, and the genital organs are quite different. Measurements: Male, abdomen 26.0-28.0 mm., hind wing 30.0-31.0 mm.; female, 26.0, 31.0 mm.

Asahina's account of the larva of *L. insularis* is not illustrated and does not admit comparisons with other known larvae of the genus. I am acquainted with only those of the Malaysian *L. biappendiculata* (Selys) and *L. magnificata* (Selys), several examples of the latter having been reared from larvae. A full-grown *L. magnificata,* shortly after the last ecdysis, is illustrated (fig. 23, *a*). The young larva was obtained from a bamboo stump at Darungan (Mt. Semeru, east Java).

Genus **Agrionoptera** Brauer

Agrionoptera Brauer, 1864, Zool.-bot. Ges. Wien, Abh. **14**: 159, 163 (type: *A. nicobarica* Brauer, 1865, op. cit., **15**: 978, male, female, Nicobar Is., fixed by Kirby, 1890, Cat., 180).—Ris, 1910, Cat. Coll. Selys, 10, Lib. **2**: 133 (type: *Libellula insignis* Rambur, 1842, Hist. Nat. Ins. Neuropt., 123-124, male, Java).

DISTRIBUTION: This genus ranges from northern India through Malaysia and the Philippines to New Caledonia, the New Hebrides, and Union Is.

Agrionoptera is a heterogeneous unit. Only three very different polytypic species have been recognized, the Philippine *A. bartola* Needham and Gyger being evidently conspecific with *A. sexlineata* Brauer, or only racially distinct from that species. All species are forest-haunting insects and are chiefly confined to lower altitudes. Adults are usually most abundant near the seacoast, occurring in the shelter of jungle marshes and pools behind the beach. Females may wander far from their breeding places, congregating in sunlit spots and clearings. They breed in clear stagnant water, the adults keeping to shady places. The larva is clean-bodied and has strongly marked legs and wings (figs. 24, 25). I published a detailed description with many figures of the ultimate instar larva of the southern Moluccan subspecies of *A. insignis* (nearest *A. i. similis*) in 1930 under the wrong name (?*Diplacina phoebe* Ris, Treubia **7**, Suppl.: 323-326, pls. 8, 9).

Superspecies **Agrionoptera insignis** Rambur

Libellula insignis Rambur, 1842, Hist. Nat. Ins. Neuropt., 123-124 (male: Java; type, male, Brussels Mus.).

Agrionoptera nicobarica Brauer, 1865, Zool-bot. Ges. Wien, Abh. **15**: 978 (male, female, Nicobar Is.).

Agrionoptera is a heterogeneous unit. Only three very different polytypic

Agrionoptera quatuornotata Brauer, 1867, Zool.-bot. Ges. Wien, Abh. **17**: 289, 298-299 (male, North Celebes).

Agrionoptera similis Selys, 1879, Mus. Civ. Stor. Nat. Genova, Ann. **14**: 303 (male, female, Ternate, Halmahera).—Lieftinck, 1949, Treubia **20**: 363-364 (subspeciation).

Agrionoptera insignis var. *papuensis* Selys, 1879, Mus. Civ. Stor. Nat. Genova, Ann. **14**: 303 (lectotype, by present designation, male, northwest coast of New Guinea, Mus. Genova).

Agrionoptera insularis Kirby, 1889, Zool. Soc. London, Trans. **12** (9): 336-337 (male, female, Solomon Is.; type, male, Santa Anna I.).

Agrionoptera insignis and subspecies, Tillyard, 1906, Linn. Soc. New South Wales, Proc. **31**: 485-487; 1908, op. cit. **33**: 641-645.—Ris, 1910, Cat. Coll. Selys 10, Lib., **2**: 134-142, figs. 98-100; 1919, op. cit. 16^2, Lib., **9**: 1068-1069.—Kimmins, 1936, Ann. Mag. Nat. Hist. X, **18**: 75-76; 1953, op. cit., XII, **6**: 243-244, figs., table.—Asahina, 1940, Tenthredo **3** (1): 13-15 (Micronesia).—Lieftinck, 1942, Treubia **18**: 466-473, pl., 24 figs.; 1948, op. cit., **19**: 292-294; 1951, Am. Mus. Nov. **1488**: 32-33; 1953, Naturf. Ges. Basel, Verh. **64**: 198.

Agrionoptera allogenes Tillyard, 1908, Linn. Soc. New South Wales, Proc. **33**: 641-643 (male, female, north Queensland).

Agrionoptera insignis chalcochiton Ris, 1915, Tijdschr. Ent. **58**: 15-16 (male, female, Simalur I.).

Agrionoptera insignis dorothea Fraser, 1927, Ind. Mus., Rec. **29**: 65-66 (male, female, Bengal).

Agrionoptera insignis cynthiae Lieftinck, 1942, Treubia **18**: 469, 472-473, pl. 24, fig. 19 (male, female, Tanimbar Is.).

Agrionoptera insignis nereis Lieftinck, 1948, Treubia **19**: 292-294, fig. 7 (male, female, Engano I.).

Agrionoptera insignis lifuana Kimmins, 1953, Ann. Mag. Nat. Hist. XII, **6**; 243-244, figs. 1-3, table (male, female, Loyalty Is.; New Hebrides).

DISTRIBUTION: That of the genus. Isolated records from north Bengal and the Darjeeling district are based on insufficiently known material.

Odonatists familiar with the species of this genus will admit that the *A. insignis* assemblage shows that the affinity of these forms to one another is much closer than to other species of the same genus and that they probably evolved as geographical forms of some ancestral species in comparatively recent times. Present-day forms resemble each other not only in "facies," color, and wing venation, but in genital structure. Unfortunately, all characters separating them are variable, often to a considerable extent, and even structural differences (male genitalia and appendages) are slight and of practical use only on close inspection and comparison of a good series in combination with other characters.

The group presents an extraordinary array of forms, many of which are only slightly different from island to island and merge imperceptibly one into the other. Others (for example, the Celebes form *quatuornotata*) differ so much in stature and color that they seem to have reached specific status; in well-segregated forms like *quatuornotata*, whether a certain unit is called an "initial species" or is still considered a subspecies, depends chiefly upon the author's conception of the taxonomic species.

An examination of nearly 800 individuals of *insignis*, collected from all over its enormous range, has led me to consider this a species-group (Artenkreis) that can be divided into assemblages with the status of species which, together, form the superspecies *insignis* (see map, fig. 19). If an isolated species peculiar to the Tanimbar Islands (*cynthiae*) is omitted, the two most comprehensive units can be split into a number of subspecies not outlined on

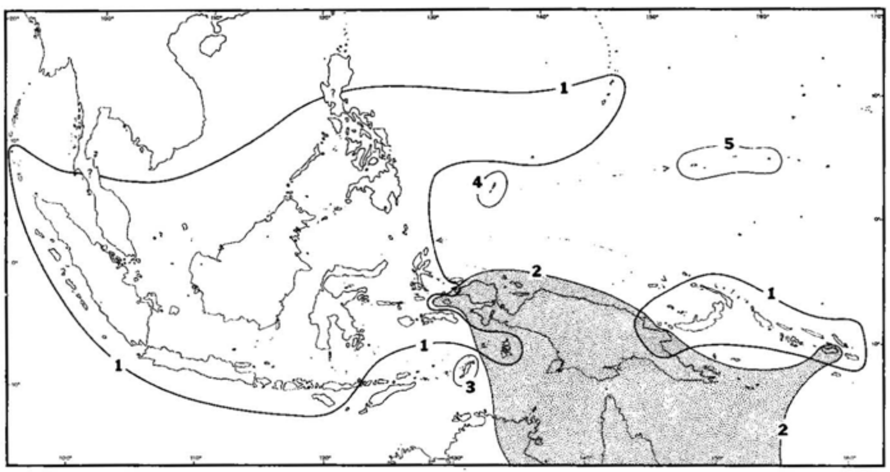


FIGURE 19.—Geographical distribution of superspecies *Agrionoptera insignis* (in part). 1, *A. insignis* (including subspecies *yapensis* and *guamensis*), showing discontinuous distribution of *A. i. similis* and its overlap with *A. papuensis* in western and eastern New Guinea. 2, *A. papuensis* (stippled), showing overlap with *A. insignis similis* in western and eastern New Guinea and again on Guadalcanal by its subspecies *A. p. insularis*. 3, *A. cynthiae* (Tanimbar Is.). 4, *A. cardinalis* (Palau). 5, *A. sanguinolenta* (Truk and Ponape).

the map, but enumerated below. As this account is of a faunistic nature, a discussion of all characters required to separate the species and subspecies would amount to monographing the superspecies *insignis*, a task that must be left to the future. The accompanying map, the key, and the drawings of genital organs may help to give an impression of the affinities within the group. To obtain a more complete record of the characters of the various forms, the references cited above should be consulted.

In the western part of its range, the differentiation of *insignis* into insular subspecies can be fairly easily understood when good series from each locality are available for comparison. Several of the islands (or groups of islands) in the Indonesian archipelago are inhabited by forms with differences in color and venation that are clearly of subspecific value. Examples of this kind are enumerated below. Though allopatric hybridization between these insular populations doubtlessly occurs where the ranges meet in the border zones, most of these forms are still recognizable; added to these, a number of still undescribed insular subspecies which occur elsewhere can be distinguished. These are probably also geographical representatives of a single species. Geographically, however, the group by no means presents the picture of an ordinary polytypic species. In my partial revision of *A. insignis* published in 1942 (Treubia **18**: 469, 472-473), I pointed out that east of the Moluccas, on New Guinea as well as on several surrounding island groups, some locally different forms heretofore considered separate races (and included accordingly under *insignis*) occur together without interbreeding. Thus, on the Aru and Kei Islands there is definite proof of a southern Moluccan race allied to *similis* occurring side by side with the Australo-Papuan *allogenes*. An even more striking example of regional overlap is presented by *similis* in New Guinea. The latter form is hardly distinguishable from Moluccan populations of *similis* but, strangely, inhabits an isolated zone comprising the northeastern portion of New Guinea, the Bismarcks and most of the Solomon chain, including Guadalcanal (see map); it is thus seen to penetrate into the territory of *papuensis* along the New Guinea coast. There is a great gap between the northern Moluccas and this eastern enclave of *similis,* which, according to present knowledge, is not bridged by any form in the intermediate zone. However, on one of the westernmost satellite islands of New Guinea (Salawati) and also on Biak (Schouten Islands), an overlap of the ranges of *i. similis* and *p. papuensis* exists which seems to result in a certain amount of hybridization; but the material is insufficient to draw conclusions. Another interesting overlap is that of *similis* on Guadalcanal, where it occurs together with the Australian representative of *papuensis, allogenes*. In my analysis of the fauna of the Bismarcks and Solomons (1949) I have on this evidence treated *similis* as specifically distinct from *papuensis*. Having again compared it with our extensive series of *insignis* (Malaysia) and with those of *quatuornotata* (Celebes), I believe that *similis* is best included in the western subspecies group of *insignis,* as it was before, and that the eastern representatives should be kept separate as a distinct subspecies-group under the oldest name, *papuensis*. There appear to be no intergrades between *i. similis* and *p. papuensis* in northeast New Guinea, nor between the stoutly built, undescribed *similis*-like race and the slender *p. allogenes* which together inhabit the Kei and Aru islands, as well as the island of Guadalcanal. In my opinion the pattern of distribution indicates that these insects were formerly allopatric

subspecies of a single polytypic species, but at the present time demonstrate a further stage of their evolution, namely, an expansion and overlap of their ranges without hybridization, proving thereby to have attained the status of full species. If the taxonomist were to classify the same insects from different islands merely on the basis of their morphological distinctness, he would probably decide that they were subspecies; but they do occur together and in all probability are also ecologically separated. With respect to the two different forms of *p. allogenes* occurring in northern Queensland, it is uncertain whether they replace each other geographically or present a similar overlap due to re-extension of the area by one form (or both) after they became separated and modified.

A. cynthiae (Tanimbar Islands) is regarded as a species, not primarily because of the geographically isolated habitat, but because of its peculiar scheme of coloration and other morphological features, which deviate considerably from those linking together most other forms.

Turning to the Micronesian fauna, it is at once evident that the members of *Agrionoptera* are differentiated into a number of diverse species and subspecies which are probably of different origin. Thus it appears likely that *guamensis* and *yapensis,* though differing markedly from each other, both came from an ancestral stock in the Malaysian-Philippine area and that they have reached the southern Marianas from the Philippines. They exhibit many characters in common with the *insignis* subspecies group and are most conveniently treated as insular races of that species. A third member of the group, *cardinalis,* inhabits the Palau Islands; and in spite of its habitat being geographically much nearer to the Philippines, exhibits characters altogether different from those of the *insignis* races of Yap and the southern Marianas; in point of fact it approaches more closely the representative forms occurring in the Caroline Islands. Neither the Palau nor the Caroline *Agrionoptera* can be linked with any other species in Melanesia and they apparently represent separate and early invasions of Micronesia, independent of those of the forms occurring in the Yap-Guam-Saipan area. The absence of *Agrionoptera* from Kusaie is of interest because it may indicate the pathway by which these highly modified species invaded southern Micronesia; that is, not from the east but perhaps from the continent of New Guinea. As to the possible routes of colonization used by the various forms to attain their present distribution in the western Pacific, nothing definite can be said. The populations inhabiting the eastern Solomons, New Hebrides, and New Caledonia are little known, but these were possibly derived also from a common ancestral stock in the Papuan region.

As a preliminary to a monographic revision, I have attempted to study also the penile structures of the principal taxonomic entities. This investigation does not, however, appear to furnish any clue to the origin and relationships of the various forms beyond that it supports the available evidence already mentioned.

guamensis and *yapensis*, though differing markedly from each other, both came

The illustrations are drawn to show only outlines and principal lobes (lateral and medial lobes, and cornua) of slightly moistened penes in relaxed condition, submersed in glycerine. A casual inspection of figure 21 suffices to demonstrate again the little differentiation and great uniformity in structure of this compact group, even *A. papuensis* being hardly different from the western subspecies of *A. insignis*. As to the Micronesian members, the less elongate form of the last penile segment of the Palau and southern Caroline representatives (fig. 21, *f-h*) indicates their derivation from a single immigrant, which has probably strayed into the islands from the south at an earlier date than the one that came from the West and invaded Yap and the southern Marianas (fig. 21, *e*).

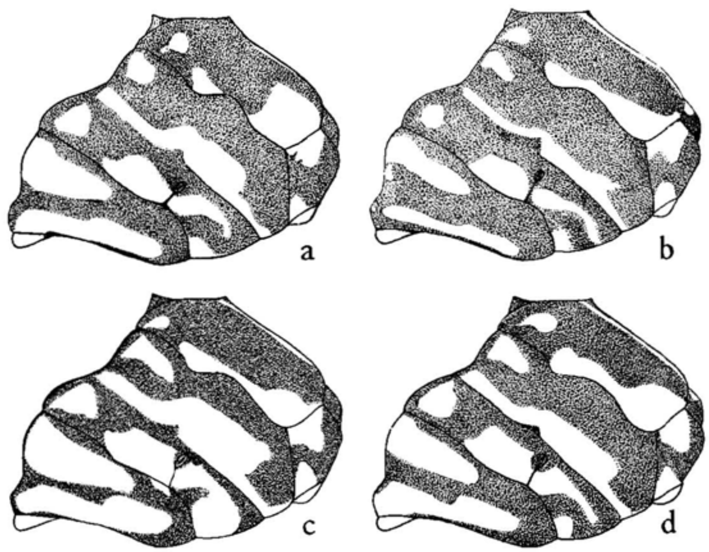


FIGURE 20.—Color pattern of male synthorax: **a,** *Agrionoptera insignis yapensis* (Yap); **b,** *A. cardinalis* (Palau); **c,** *A. sanguinolenta pusilla* (Truk); **d,** *A. s. sanguinolenta* (Ponape).

On the basis of a comparative study of the morphology, I have arrived at the following preliminary arrangement of the *Agrionoptera* group. Topotypes have been examined of all those listed except the subspecies (?) *dorothea*.

insignis Rambur
- *insignis* Rambur: Malaysia to Sumba and Palawan
- ? *dorothea* Fraser: Bengal
- *nicobarica* Brauer: Nicobar Islands
- *chalcochiton* Ris: Simalur Island and Mentawei Islands
- *nereis* Lieftinck: Engano Island
- *quatuornotata* Brauer: Celebes, Salajar (Saleier) Island, Tanahdjampea Island, Buton Island, Tukangbesi Islands, South Sangihe Islands (Tahulandang), Banggai Islands, Sula Islands

subsp. inedit.: Talaud Islands
similis Selys: North Moluccas, Philippine Islands, Salawati Island and northeast New Guinea, Bismarcks, Solomon Islands (Bougainville, Shortland, Treasury, and Guadalcanal)
subsp. inedit.: South Moluccas, Banda Islands, Kei Islands, Aru Islands
insularis Kirby: Solomon Islands (Santa Anna, Alu, Sikaiana Atoll, Ugi, and Rennell)
guamensis, n. subsp.: Guam, Saipan, and Tinian
yapensis, n. subsp.: Yap
cynthiae Lieftinck, new status: Tanimbar Islands
papuensis Selys, new status: West, southwest and east New Guinea to the Louisiade Islands
allogenes Tillyard, new status: North Queensland, Kei Islands, Aru Islands, south New Guinea, Solomon Islands (Guadalcanal)
subsp. inedit.: North Queensland (parts)
lifuana Kimmins, new status: Loyalty Islands and New Hebrides
cardinalis, n. sp.: Palau
sanguinolenta, n. sp.: Ponape
pusilla, n. subsp.: Truk

Since a key based on the specific and subspecific differences between the whole *A. insignis* complex would go beyond the scope of the present work and include too many characters not necessary for the present purpose, the following descriptive key is designed only to serve for the limited Micronesian fauna. Distinguishing characters mentioned in this key are not repeated under each species, except in certain cases for the females.

Descriptive Key to Males of Micronesian Species and Subspecies of Agrionoptera

1. Triangle of fore wing traversed once; internal triangle three-celled, occasionally four-celled; area posterior to Cu_2 of fore wing, at least with some duplicated cells; discoidal field of fore wing often commencing with three cells at triangle followed by two rows up to base of bridge, thence again with three or more rows; cubital space of hind wing generally twice or even thrice traversed but often with only a single cross vein; neuration close; antenodals 12 to 17; anal loop well formed, comprising 10 to 12 cells; M_2 and Rs slightly but distinctly sinuous in outer half. Yellow antehumeral (mesepisternal) band obliterated, nearly always broken up into three spots, one large subrectangular ventral patch, and two smaller juxtahumeral spots of irregular shape dorsal to it (fig. 20, *a*). Lobus posterior (genital lobe) relatively large, moderately constricted basally in side view and with its distal edge rounded; inner branch of hamulus equal in length or a little shorter than outer branch and directed obliquely inward (fig. 22, *a, c*), outer branch in caudal view scalelike, subcircular in outline. Apex of superior anal appendages in side view usually bluntly pointed (fig. 22, *b, d*). (S. Marianas and Yap.) Subspecies of *A. insignis*.......... 2

Triangle of fore wing free; internal triangle two-celled; area posterior to Cu_2 of fore wing with only a single row of cells; discoidal field of fore wing with two rows of cells as far as base of bridge or somewhat beyond that level; cubital space of hind wing with a single cross vein; neuration more open; antenodals 11 to 13; anal loop rather weak, comprising seven to nine cells; M_2 and Rs scarcely sinuous in outer half. Yellow antehumeral (mesepisternal) band shaped differently: nearly always obliterated and irregular in outline but lowermost division much narrower and, after a slight constriction, con-

tinued upward along suture, hence only one isolated juxtahumeral dot just ventral to ante-alar triangle (fig. 20, *b-d*). Dorsum of red abdominal tergites 2 to 7 at most with posterior border narrowly lined with black; ventral surface of tergites 4 to 10 black. Lobus posterior (genital lobe) relatively smaller, more constricted basally; inner branch of hamulus more protuberant, less incurved, outer branch more irregular in shape and in caudal view tongue-shaped and somewhat undulated. Apex of superior anal appendages in side view slenderer and usually more acuminate (fig. 22, *h, j, l*). Size relatively smaller, greatest width of abdomen at apex of segment 7: 0.8-1.2 mm. (Palau, Truk, and Ponape) 3

2. Labium with joint median black band more or less triangular in outline, widest basally, hence inner border of lateral lobes only narrowly black distally. Costal side of fore wing triangle less than half length of proximal side; hind wing with two, rarely three, Cux; antenodals 12 to 15. Abdominal tergites 3 to 8 unicolored red, 9 and 10 black, but dorsum of 9 occasionally with vestige of red spot on each side near base. Genitalia and supraanal appendages in figure 22, *c-d*. Size rather large, abdomen broader, greatest width at apex of segment 7: 1.5 mm. Abdomen 26.0-28.0 mm., hind wing 29.0-30.0 mm., pterostigma 3.0 mm. (Guam) .... **30. insignis guamensis**

   Labium with joint median black band broader, widest halfway its length and with sides more nearly parallel, hence inner border of lateral lobes broadly black distally. Thoracic color pattern (fig. 20, *a*). Costal side of fore wing triangle longer, more than half length of proximal side; hind wing with one or two Cux in about equal proportion; antenodals 14 to 17. Abdominal tergites 3 to 7 red, but ventral surface of 4 to 7 black, and apical margins of dorsal surface finely but progressively more broadly ringed with black; 8 to 10 invariably black. Genitalia and supraanal appendages in figure 22, *a, b*. Size a little smaller, abdomen narrower, greatest width at apex of segment 7: 1.0-1.2 mm. Abdomen 24.5-26.0 mm., hind wing 27.0-28.0 mm., pterostigma 2.5-2.8 mm. (Yap) .... **29. insignis yapensis**

3. Dorsum of abdominal tergite 9 wholly black. Yellow antehumeral (mesepisternal) band rather abruptly expanded ventrad; pleural pattern black and yellow in about equal proportion (fig. 20, *d*); metallic green markings moderately shiny; ventral surface of metepimeron mat black, poststernum with roundish or subtriangular yellow central patch. Labium with joint median black band subparallel-sided, only little narrowed toward apex. Basal half to two-thirds of abdominal segment 1 black above, rest of dorsum red but sides bright yellow; posterior border of 2 to 7 unmarked, or with extremely fine hairline of black; 8 with narrow black apical ring. Cu_1 in fore wing very feebly arched. Genitalia and supraanal appendages in fig. 22, *i, j*. Abdomen 24.0-24.5 mm., hind wing 25.0-26.0 mm., pterostigma 2.0 mm. (Ponape) .... **32. sanguinolenta sanguinolenta**

   Dorsum of abdominal tergite 9 at least partly red. Yellow antehumeral (mesepisternal) band less abruptly expanded ventrad. Labium with joint median black band widest basally, distinctly narrowed toward apex 4

4. Pale ground color of thoracic pleurae extensive, preponderating over dark banding, which is brilliant metallic green (fig. 20, *c*); ventral surface of metepimeron broadly yellow posteriorly, poststernum more extensively yellow but its hind margin black. Labium with joint median black band narrowly triangular, occupying only one-fifth of entire surface. Costal side of fore wing triangle much longer, more than half length of proximal side; Cu_1 very feebly arched. Dorsum of abdominal segment 1 black with transverse yellow stripe along posterior border, sides wholly bright yellow; 2 red with small basodorsal and three larger subconfluent lateral yellow spots; 9 entirely red bordered with black apically. Genitalia and supraanal appendages in figure 22, *k, l*. Size small, abdomen 21.5-23.0 mm., hind wing 23.0-25.0 mm., pterostigma 1.8-2.0 mm. (Truk) .... **33. sanguinolenta pusilla**

Pale ground color of thoracic pleurae more restricted, bronze-black banding predominating and with metallic blue or green luster (fig. 20, *b*); ventral surface of metepimeron mat black, narrowly lined with yellow posteriorly, poststernum yellow bordered with black behind. Labium with joint median black band occupying almost one-third of entire surface. Costal side of fore wing triangle less than half length of proximal side; Cu_1 distinctly arched. Dorsum of abdominal segment 1 reddish black, sides with bright yellow spot; 2 red with small diffuse lateral yellow spot; basal one-third to one-half of dorsum of 9 red. Genitalia and supraanal appendages in figure 22, *g*, *h*. Size larger, abdomen 22.0-26.0 mm., hind wing 24.5-27.5 mm., pterostigma 2.0-2.3 mm. (Palau)..**31. cardinalis**

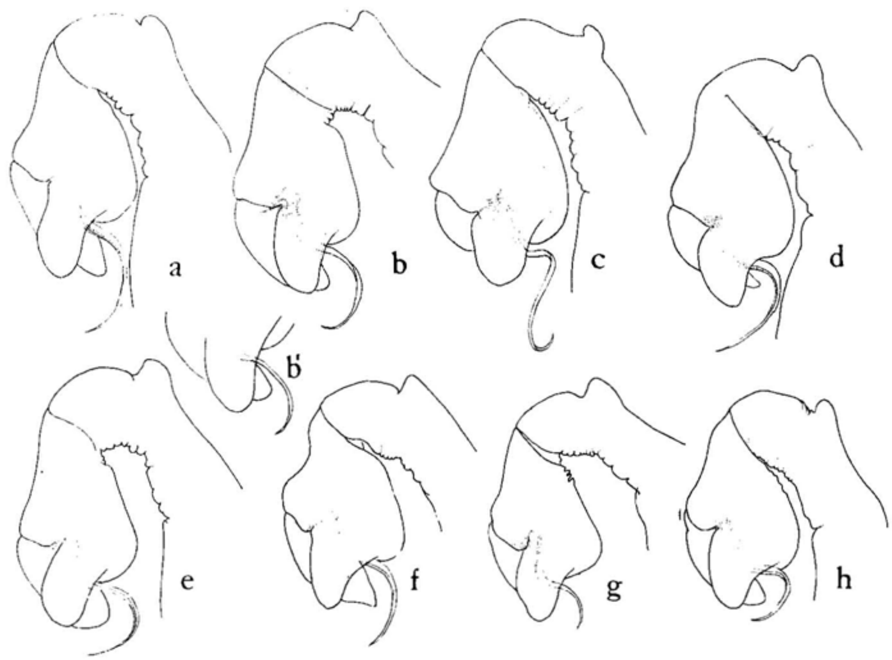


FIGURE 21.—Penes of *Agrionoptera*, lateral view: **a,** *A. insignis insignis* (western Java); **b, b',** *A. i. quatuornotata* (northern Celebes); **c,** *A. i. similis* (Halmahera); **d,** *A. papuensis* (northern New Guinea); **e,** *A. insignis yapensis* (Yap); **f,** *A. cardinalis* (Palau); **g,** *A. sanguinolenta pusilla* (Truk); **h,** *A. s. sanguinolenta* (Ponape).

29. Agrionoptera insignis yapensis Lieftinck, n. subsp. (figs. 20, *a*; 21, *e*; 22, *a*, *b*).

Agrionoptera insignis quatuornotata, Ris, 1910, Cat. Coll. Selys, 10, Lib. 2: 135-136, 138-139 (part; male, female, Yap).

Agrionoptera insignis, Asahina, 1940, Tenthredo **3** (1): 13-15, 21 (male, female, Yap).

General appearance of typical *insignis* from Java and agreeing with it in venation and thoracic markings; black apical rings to abdominal segments 3 to 7 also present though

very narrow. Wing bases often diffusely tinged with yellow, but in several specimens practically uncolored. Both sexes differ from *i. insignis* as follows: Joint median black band on labium considerably broader and not narrowed distad; dorsum of abdominal segment 1 and prejugal division of 2 blackish, postjugal division red (*insignis:* segments 1 and 2 wholly obscured, but both segments with median row of coalescent yellow spots). All females androchromatic, abdomen colored exactly as in male. One undersized female (abdomen 22.3, hind wing 27.0 mm.) has labium black except exterobasal spot of yellow on side lobes.

Holotype, male (US 65144), and allotype, female, Yap, Ruul district, July-Aug. 1950, Goss. Yap: Both sexes, Ruul, Gagil and Tomil district, South Yap, July-Aug. 1950, Goss; both sexes, Aug., Oct. 1952, Krauss; both sexes, behind Yaptown and Mt. Madaade, Oct.-Nov. 1952, Gressitt; one pair, Dugor-Rumu, Dec. 1952, Gressitt; female, Mt. Tabiwol, 150 m., Nov. 1952, Goss; female, Rumung I., Oct. 1952, Krauss. A very homogeneous series of 17 males and 21 females.

DISTRIBUTION: Western Caroline Is. (Yap).

The male of this new subspecies is easily distinguished from Philippine examples of *insignis* from Basilan I. (which come nearest to the Moluccan *i. similis*) by the presence of black rings at the apex of segments 3 to 7, and also by having a narrower and more slenderly built abdomen. All females known from the Philippines seem to have black longitudinal bands on the dorsum of the abdominal segments.

30. Agrionoptera insignis guamensis Lieftinck, n. subsp. (fig. 22, *c, d*).

Agrionoptera insignis, Asahina, 1940, Tenthredo **3** (1): 13-15, 21 (male, female, Saipan, Tinian).

Agrionoptera insignis insignis, Schmidt, 1941, Deutsch. Ent. Ges., Mitt. **10**: 25-26 (female, Saipan).—Swezey and Williams, 1942, B. P. Bishop Mus., Bull. **172**: 4 (Guam, "quite common").

Immediately distinguished from *yapensis* by its larger size, more robust build, and broader abdomen, giving it a more *similis*-like appearance. Thoracic markings similar to those of *yapensis*, but coalescent black lateral stripes all a little narrower. Females androchromatic, but distal margins of segments 3 to 7 finely bordered with black, apical one-third to one-fourth of 8 also black. Typical *similis* (northern Moluccas), besides being larger and having black abdominal segment 8, not red, is readily separated from *guamensis* by quite different shape of yellow lateral thoracic markings (Lieftinck, 1942, Treubia **18**: pl. 24, fig. 20) and by presence of only single cross vein in cu of hind wing.

Holotype, male (US 65777), and allotype, female, Guam, May 1945, Bohart and Gressitt. Guam: Three males, three females, Mt. Santa Rosa, May 1945, and south end of Guam, July 1945, Bohart and Gressitt; Mt. Alifan, Apr. 1946, Krauss.

DISTRIBUTION: S. Mariana Is. (Guam; Saipan and Tinian, atypical ?).

This corresponds with the diagnosis given by Asahina of specimens from Saipan and Tinian, which accordingly can be assigned to the present subspecies. I have seen only material from Guam.

31. Agrionoptera cardinalis Lieftinck, n. sp. (figs. 20, *b*; 21, *f*; 22, *g*, *h*).

Agrionoptera insignis, Selys, 1882, Soc. Espan., An. **11**: 10 (of separate) (Palau).—Asahina, 1940, Tenthredo **3**: 13-14, 21 (male, female, Palau).

In addition to characters mentioned in key, male distinguished from *A. sanguinolenta* by slight differences in shape of hamule and lobus posterior of genitalia, and also by straighter superior appendage. Thoracic color pattern (fig. 20, *b*) shows extreme reduction of yellow markings, mesepimeral band scarcely expanded in middle; ventral surface obscured, but poststernum colored more extensively yellow than in *sanguinolenta*, bearing large subtriangular patch of yellow occupying most of surface. Wings relatively broader and more densely reticulated, all principal nervures being more strongly curved than in *sanguinolenta*. Abdominal segments 2-8 either entirely red or with traces of transverse black hairline at posterior border of each. Terminal segment of penis (fig. 21, *f*) short and oval, its ventral surface strongly sinuous in profile view, greatest width and length in ratio of 6.1: 10.0. Accessory genitalia in figure 22, *g*; superior appendages in figure 22, *h*.

Narrower fore wing triangle, convex Cu_1, and more abrupt bend of veins M_3 and M_4 toward wing margin are additional characters by which the female also can be separated from that of *sanguinolenta*. All females are androchromatic and have segments 2-7 very narrowly bordered with black, but only the basal half to three-fourths of the 8th abdominal segment remains red.

Description based on six males and four females.

Holotype, male (US 65145) and allotype, female, Babelthuap, Palau Is., Ulimang, Dec. 1947, Dybas. Babelthuap: Both sexes, Ulimang, Dec. 1947, Dybas, and Ngatpang, 65 m., Mar. 1952, Gressitt. Koror: Two females, Nov. 1947, Dybas, and Aug.-Sept. 1949, Langford. Angaur: Female, Nov. 1949, Owen. Ngurukdabel: Two males, Ngaremediu, Dec. 1952, Gressitt, May 1957, Sabrosky.

DISTRIBUTION: Western Caroline Is. (Palau).

As to the venation and the shape of the posterior genital lobe of the male, this new species suggests remote affinities with *A. papuensis* and *A. insignis,* but it comes nearest *A. sanguinolenta* in every other respect, including the structure of the penile organ.

32. Agrionoptera sanguinolenta Lieftinck, n. sp. (figs. 20, *c*, *d*; 21, *g*, *h*; 22, *i-l*).

Agrionoptera insignis quatuornotata, Ris, 1910, Cat. Coll. Selys, 10, Lib. **2**: 135-136, 138-139 (part, male, Ponape).

Agrionoptera insignis, Asahina, 1940, Tenthredo **3** (1): 13, 15, 21 (male, female, Ponape).

Generally similar to *A. cardinalis,* but differing conspicuously in male genitalic characters and venation. Chiefly characterized by narrow wings, open venation, and relatively short pterostigma, combined with small size and very slender build. Thoracic color pattern in fig. 20, *d;* ventral surface black except isolated, subtriangular or diamond-shaped yellow dot in middle of poststernum. Tips of veins M_3 and M_4 evenly curved toward margin of wing. Terminal segment of penis (fig. 21, *h*) short and oval, its ventral surface moderately sinuous in side view, greatest width and length in ratio of about 5.8-6.0: 10.0. Accessory genitalia, fig. 22, *i;* superior appendages, fig. 22, *k*. Female androchromatic; color of abdomen as in male, but segment 8 often with pair of laterobasal red spots and occasionally entire basal one-third of this segment red.

In male from Mokil Atoll, joint median black band of labium narrowed distally, but otherwise specimen does not differ from examples of Ponape.

Holotype, male (US 65146), allotype (US), female, and series of both sexes, Ponape, Agric. Exper. Sta. and Mt. Paipalap, 240 m. (male), June-Sept. 1950, Adams. Ponape: Both sexes, Colonia, Aug. 1928, Uchiyama; Feb. 1948, Dybas; July 1949, Owen; male, Salapwuk, Feb. 1936, Ono; *"A. allogenes,"* det. J. G. Needham; female, south of Nanpohnmal, Jan. 1953, Clarke; male, Sokehs I., June-Sept. 1950, Adams. Two ultimate instar larvae, Ponape, Mus. Godeffroy, no. 15023 (Hamburg Museum).

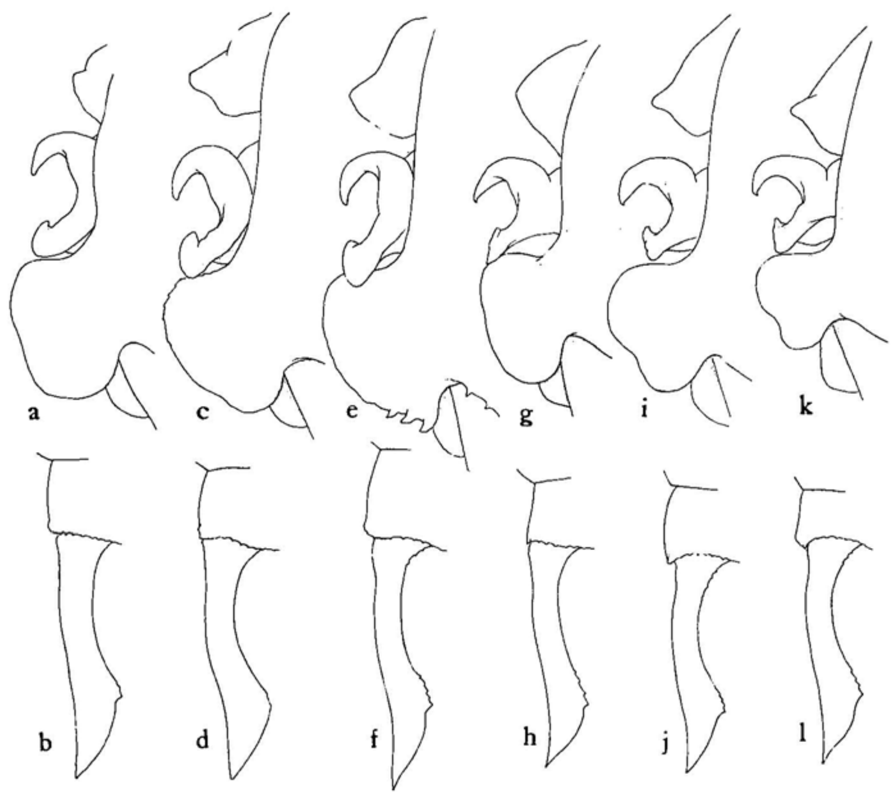


FIGURE 22.—Male genitalia (upper row), and lateral view of right superior appendage (lower row) of *Agrionoptera:* **a, b,** *A. insignis yapensis* (Yap); **c, d,** *A. i. guamensis* (Guam); **e, f,** *A. papuensis* (Southwest New Guinea); **g, h,** *A. cardinalis* (Palau); **i, j,** *A. s. sanguinolenta* (Ponape); **k, l,** *A. s. pusilla* (Truk).

DISTRIBUTION: Eastern Caroline Is. (Ponape; Mokil).

CAROLINE ATOLLS. MOKIL (east of Ponape): Male, Kalap islet, July 1949, Owen.

The two larvae in the Hamburg Museum are alcoholic specimens, entirely discolored, but show all features characteristic of the genus (fig. 24, *a*).

33. Agrionoptera sanguinolenta pusilla Lieftinck, n. subsp. (figs. 20, *c*; 21, *g*; 22, *k, l*).

Agrionoptera insignis, Asahina, 1940, Tenthredo **3** (1): 13, 21 (male, female, Truk).

Stature very slender; integument weakly sclerotized; dark markings of thorax restricted laterally, very brilliant metallic green, especially on dorsum (fig. 20, *c*); ventral surface light yellowish, only metepimeral surface outwardly and tiny transverse streak bordering poststernum black. Dorsal surface of abdominal segments 2 to 9 unicolored scarlet; dorsum of 1 black, sides and transverse apical streak bright yellow; prejugal portion of 2 occasionally also somewhat obscured and at times a median longitudinal dot of yellow present on postjugal portion of segment, most conspicuous in female. Accessory genitalia in figure 22, *k*; superior appendages in figure 22, *l*; terminal segment of penis (fig. 21, *g*) scarcely differing from that of typical subspecies. Female androchromatic, very similar to male, except for sexual characters; all segments usually very finely lined with black posteriorly, segment 9 often somewhat obscured distally.

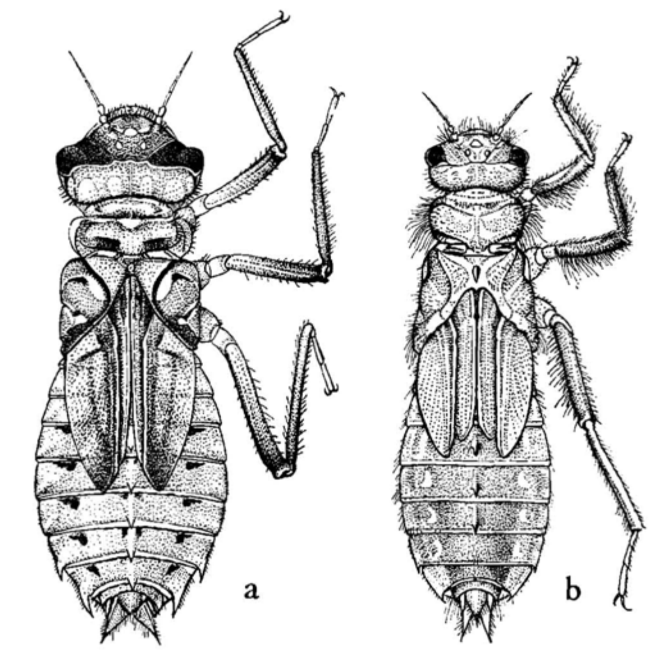


FIGURE 23.—Ultimate instar larvae: **a,** *Lyriothemis magnificata,* eastern Java (live specimen), length 23 mm.; **b,** *Orthetrum sabina viduatum,* central New Guinea, length 20 mm.

Holotype, male (US 65147), allotype (US), female, and series of both sexes, Nantaku (Civil Adm. Area), Wena (Moen), Truk, Jan. 31-Apr. 27, 1949, Potts. Truk: Female, Tarik I., Jan. 1936, Ono. Series is quite uniform and comprises 20 males and 52 females.

DISTRIBUTION: Caroline Is. (Truk).

This subspecies is structurally nearly identical with *sanguinolenta* from Ponape. Although it differs markedly in size, in color, and in details of venation, it seems best to treat this form as a subspecies of the former. It is a diminutive insect, inferior in size to all other known forms of the group. The neuration appears more open and the principal veins are straighter, but these features are doubtless correlated with the small size of the insect.

Genus **Orthetrum** Newman

Orthetrum Newman, 1833, Ent. Mag. **1**: 511, note (type: *Libellula coerulescens* Fabricius, 1798, Ent. Syst., Suppl., 285; male (Italy).

This is an Old World genus containing numerous species, chiefly tropical and subtropical in distribution.

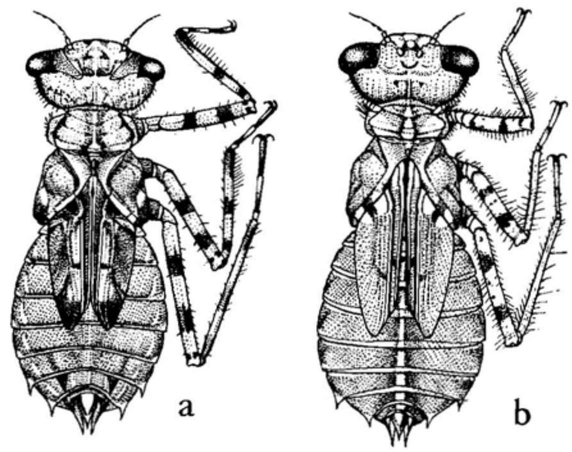


FIGURE 24.—Ultimate instar larvae: **a**, *Agrionoptera papuensis*, northern New Guinea, length 14 mm; **b**, *Neurothemis stigmatizans bramina*, northern New Guinea, length 14 mm.

34. Orthetrum sabina sabina (Drury). (Figure 23, *b*.)

Libellula sabina Drury, 1770, Illus. Exot. Ins. **1**: 114-115 (part, China), tab. 48, fig. 4 (type: China).

Orthetrum sabina, Ris, 1910, Cat. Coll. Selys, 10, Lib. **2**: 180 (key), 223-225, fig. 149.—Asahina, 1940, Tenthredo **3**(1): 15, 21 ("Tokobei, Palaus").

Orthetrum sabina sabina, Lieftinck, 1942, Treubia **18**: 477-478 (subspeciation, distrib.); 1949, Nova Guinea, n. ser., **5**: 249, 262 (id.).

DISTRIBUTION: Egypt, through Asia to north Australia and Oceania. Known also from the Ryukyus.

Only a single male of this well-known species has been reported from Tobi (Tokobei), the westernmost island of Micronesia. It breeds in still waters, preferably in cultivated areas, and is usually very common where found. The larva (fig. 23, *b*) has burrowing habits and is found in the mud and silt of shallow water, its hairy body helping to conceal it under debris and algal growth.

Genus **Neurothemis** Brauer

Neurothemis Brauer, 1867, Zool.-bot. Ges. Wien, Verh. **17**: 6-7 (type: *Libellula fulvia* Drury, 1773, Illustr. Exot. Ins. **2**: 84-85, tab. 46[2]; female, China).

This genus is found in tropical Asia, from northwest India to Japan and north Australia, and southeastward into the northwest Pacific (Union Islands). The species breed in stagnant waters.

35. Neurothemis terminata terminata Ris.

Neurothemis fluctuans race *apicalis*, Selys, 1879, Mus. Civ. Stor. Nat. Genova, Ann. **14**: 294-295 (Palau).

Neurothemis apicalis, Krüger, 1903, Stett. Ent. Zeitung **64**: 283 (Palau, after Selys).

Neurothemis terminata Ris, 1911, Cat. Coll. Selys, 13, Lib. **5**: 552 (key), 569-572 (Palau, Yap).—Schmidt, 1938, Ent. Soc. Am., Ann. **31**: 333 (catalog).—Asahina, 1940, Tenthredo **3**: 15-16 (Babelthuap, Koror, Peleliu, Yap).

Neurothemis terminata terminata, Lieftinck, 1954, Handlist, Treubia **22** (suppl.): 151-152 (references, distrib.).

As has been pointed out by Ris (1911) and Asahina (1940), Philippine and western Micronesian populations of *Neurothemis terminata* do not differ much from Java topotypes. All specimens are relatively small, but as to extent of brown wing color, males form a homogeneous series, with opaque area squarely cut off and reaching to about halfway length of pt in both fore and hind wings. Females from Palau (Koror, Angaur, and Peleliu) are androchromatic and heterochromatic in about equal proportion; but 10 out of 13 females from Babelthuap are androchromatic. The Yap series contains 25 heterochromatic females, only three colored like male; 40 percent of females have apices of wings brown inward to well proximal of pt, some with wings tinged yellowish all over membrane.

DISTRIBUTION: Malaysia; Lesser Sunda Is.; Philippine Is.; western Micronesia.

PALAU. Many, collected by Dybas, Gressitt, Krauss, Langford, and Owen (not all individuals registered). BABELTHUAP: Series, Ulimang, Dec. 1947, Dybas; Ngiwal, Sept. 1951, Gressitt. KOROR: Series, Nov.-Dec. 1947, Dybas.

ANGAUR: Feb. 1948, Dybas; July-Aug. 1945, Dybas. PELELIU: July-Aug. 1945 and Jan. 1948, Dybas. NGERGOI (GARAKAYO): Aug. 1945, Dybas.

YAP. Many, various localities, Gagil, Tomil, and Ruul districts, July-Aug. 1950, Goss; Yap, July 1951, Gressitt.

This species has reached Fais Island, but apparently does not extend farther east.

The larva of *Neurothemis* superficially resembles that of *Agrionoptera,* but well-preserved specimens always lack the black wing tips of the latter; *Neurothemis,* also, has shorter legs and the two genera can be distinguished by the different structure of the labium (figs. 24, 25).

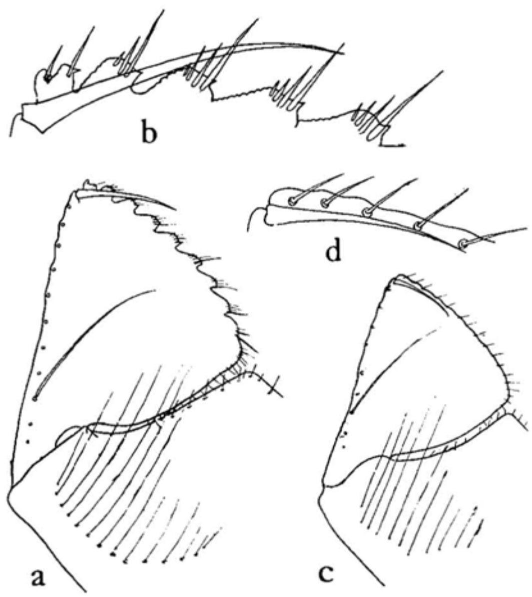


FIGURE 25.—**a**, **b**, *Agrionoptera papuensis,* northern New Guinea: *a,* structure of larval labium, inner view; *b,* distal border of labial palpus, more enlarged. **c**, **d**, *Neurothemis stigmatizans bramina,* northern New Guinea: *c,* structure of larval labium, inner view; *d,* distal border of labial palpus, more enlarged.

Genus **Diplacodes** Kirby

Diplacodes Kirby, 1889, Zool. Soc. London, Trans. **12**: 263, 307-308 (type: *Libellula lefebvrii* Rambur, 1842, Hist. Nat. Ins. Neuropt., 112-113; female, Egypt).

This is a genus with a limited number of species inhabiting the Old World tropics. Its members are of small size, the males being easily recognized by their slender, spindle-shaped abdomen. Two widely distributed species occur in Micronesia.

Key to Micronesian Species of Diplacodes

Body in teneral and subadult specimens yellow variegated with black, ground color becoming greenish or light blue with age; face and frons of adult male palest azure blue, dorsum of thorax with parallel black lines on either side and abdomen heavily striped with black; markings of thorax and abdomen in old adults disappearing, obscured, and becoming uniform pruinescent blue. Wings uncolored except for minute yellow point in cu of hind wing, and adults with small opalescent (milky-white) spot at base. Female, valvula vulvae almost half length of segment 9, scoop-shaped and scarcely emarginate, projecting markedly in side view. Average size larger, male: abdomen plus appendages 19-22, hind wing 22-23 mm..**36. trivialis**

Body in teneral and subadult specimens brownish yellow with reduced black markings, ground color becoming red with age; face and frons of adult male light red, thorax darker red, sides often with greenish hue, abdomen red with traces of black lateroventral streaks on segments 1 to 6 or 7. Wings clear, hind pair with distinct golden-yellow basal spot, veins at base are reddish. Female similar to male, but ground color yellow brown and black abdominal streaks somewhat larger. Valvula vulvae short and broad, shallowly emarginate with rounded edges, projecting slightly in side view. Average size smaller, male: abdomen plus appendages 18-20, hind wing 19-22 mm..........................**37. bipunctata**

36. Diplacodes trivialis (Rambur). (Figure 26, *b.*)

Libellula trivialis Rambur, 1842, Hist. Nat. Ins. Neuropt., 115 (male, female, Bombay; type: Bombay).

Diplacodes trivialis, Selys, 1882, Soc. Espan. Hist. Nat. An. **11**: 8 (separate) (Palau).—Ris, 1911, Cat. Coll. Selys, 12, Lib. **4**: 462 (key), 468-470, fig. 294.—Asahina, 1940, Tenthredo **3**(1): 16, 21 ("Tobi, Palaus").

DISTRIBUTION: From the Seychelles through India to Japan and the Ryukyus; eastward to Australia and the Fiji Islands.

CAROLINE ATOLLS. Tobi I.: Male, Sept. 12, 1952, Krauss.

This is one of the most widely spread and common dragonflies of the Old World. The species seems to have its distribution center between west India and the Philippines, becoming scarcer and gradually replaced by *D. bipunctata* toward the east. It breeds in all stagnant and slow-running waters, from the coast up to 3,000 m. altitude, often wandering far from its breeding places; it is salt-tolerant and given to migratory flights. It is found everywhere in cultivated country, but rare or absent in undisturbed areas.

37. Diplacodes bipunctata (Brauer). (Figure 26, *a.*)

Libellula (Diplax) bipunctata Brauer, 1865, Zool.-bot. Ges. Wien, Abh. **15**: 503 (Tahiti and New Caledonia; lectotype: Tahiti); 1866, Novara Exped., Zool. **1**: 86-88 (id.).

Diplacodes bipunctata, Kempny, 1904, Zool.-bot. Ges. Wien, Abh. **54**: 352 (Jaluit, after Asahina).—Schnee, 1904, Zool. Jahrb., Syst. **20**: 404 (Jaluit, after Asahina).—Ris, 1911, Cat. Coll. Selys, 12, Lib. **4**: 462 (key), 471-472 (Palau, Yap, Carolines, Ponape).—Oguma, 1915, Ent.

Mag. Kyoto **1**: 10 (Ogasawara, list, after Asahina); 1922, Deutsche Ent. Zeitschr., 109 (Bonin); 1932, Icon. Ins. Japon., 1925 (Ogasawara, after Asahina).—Schmidt, 1938, Ent. Soc. Am., Ann. **31**: 333 (cat.).—Asahina, 1940, Tenthredo **3**(1): 16-17, 21 (Saipan, Tinian, Rota, Babelthuap, Koror, Peleliu, Yap, Fefan, Truk, Ponape, Kusaie, Wotje).—Schmidt, 1941, Deutsch. Ent. Ges., Mitt. **10**: 26 (Saipan).—Swezey and Williams, 1942, B. P. Bishop Mus., Bull. **172**: 4 (Guam).—Lieftinck, 1942, Treubia **18**: 480 (distrib., Micronesia); 1949, Nova Guinea, n. ser. **5**: 249-250, 262 (distrib.).—Asahina, 1952, Mushi **23**: 48, 53-54, 56 (Bonin: Chichi Jima, Haha Jima).—Sakagami, 1953, Shin Konchū **6**: 23-29 (Marcus).

DISTRIBUTION: From the Moluccan islands eastward far into the Pacific; chiefly insular.

BONIN IS. Muko Jima: June 1951, Bohart. Ani Jima: Northwest Bay, Sen Zan, May 1958, Snyder. Haha Jima: Okimura, Apr.-May 1958, Snyder; July 1951, Bohart. Chichi Jima: July 1951, Bohart.

N. MARIANA IS. Pagan: July 1951, Bohart. Anatahan: Aug. 1951, Bohart.

S. MARIANA IS. Saipan: As Mahetog area, Nov. 1944, Edgar; Camp Susupe, Achugau area, Sadog Talofofo, Jan.-Feb. 1945, Dybas; Saipan, Susupe, Apr. 1946, Krauss; Saipan, Aug. 1951, Bohart. Tinian: Mar. 1945, Dybas. Rota: June 1951, Bohart. Guam: Near Pt. Manell, May 1945, and Pilgo River, May 1945, Bohart and Gressitt.

PALAU. Babelthuap: Ulimang, Dec. 1947, Dybas; Ngiwal, Sept. 1951, Gressitt. Koror: Nov. 1947-Jan. 1948, Dybas. Ngergoi: Aug. 1945, Dybas and Hagen. Peleliu: Aug. 1945, Hagen; Jan. 1948, Dybas, and July-Aug. 1945, Dybas. Angaur: Aug. 1945, Ducoff; Feb. 1948, Dybas.

YAP. Yap: Various localities, July-Aug. 1950, Goss.

CAROLINE ATOLLS. Ifaluk: July-Aug. 1953, Bates.

TRUK. Wena (Moen): Airfield area, Apr. 1949, Potts. Ton: Fosson-Chukianu, and Chukianu-Aetutu, both Apr. 1949, Potts. Tonoas (Dublon): 1952, Gressitt; Parem, March 1949.

PONAPE. Ponape: Colonia etc., Feb. 1948, Dybas; July 1949, Glassman; and June-Sept. 1950, Adams.

KUSAIE. Kusaie: Mutunlik, Feb. 1952; Jan., Mar. 1953, Clarke.

MARSHALL IS. Ebon: Feb. 1945, Wallace. Ailinglapalap: Bikajela I., Nov. 1948, Fosberg. Jaluit: Jabwar I., Apr.-May 1958, Gressitt.

GILBERT IS. Butaritari and Malun: June 1944, Enke. Tarawa: Belio and Baureawa, Aug. 1956, Brown; Marenanuka, Dec. 1957, Krauss. Marakei: Dec. 1957, Krauss.

(Also in the Bishop Museum are two males from the Ellice Is.: Funafuti, Aug. 1956, Brown.)

This very common insect is distributed throughout Australia, New Zealand, and the Pacific islands as far as the Marquesas group. This species and *Pantala flavescens* are the dominant dragonflies of the region and both have strong migratory tendencies. In the eastern part of the Malay region *D. bipunctata* is rare and scattered on islands between Celebes and Australo-Papua, as it is in a few disturbed mountain valleys of New Guinea. However, it is common all over Micronesia, replacing *D. trivialis*.

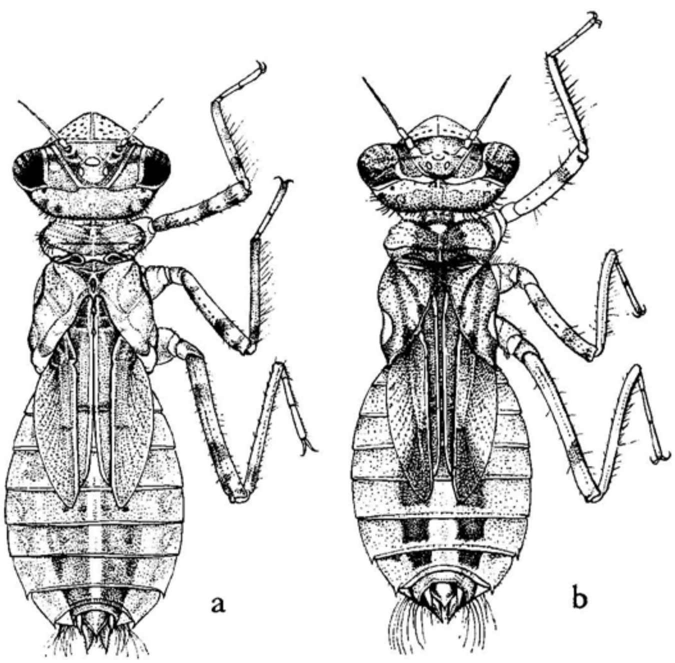


FIGURE 26.—Ultimate instar larvae: **a,** *Diplacodes bipunctata,* central New Guinea, length 11.5 mm; **b,** *D. trivialis,* western Java (live specimen), length 11 mm.

Genus **Zyxomma** Rambur

Zyxomma Rambur, 1842, Hist. Nat. Ins. Neuropt., 26, 30, pl. 2, fig. 4, *d* (type: *petiolatum* Rambur, op. cit., 30; male, Bombay).

38. Zyxomma petiolatum Rambur (fig. 27, *a*).

Zyxomma petiolatum Rambur, 1842, Hist. Nat. Ins. Neuropt., 30-31, pl. 2, fig. 4, d (type: male, Bombay).—Ris, 1913, Cat. Coll. Selys, 15, Lib. **7**: 901 (key), 903-905, fig. 523.—Asahina, 1940 Tenthredo **3** (1): 19, 21 (Koror).

Easily known by its dull-brown coloration, small thorax, and swollen basal abdominal segments. Long slender abdomen and huge eyes give the insect an aeshnine-like appearance.

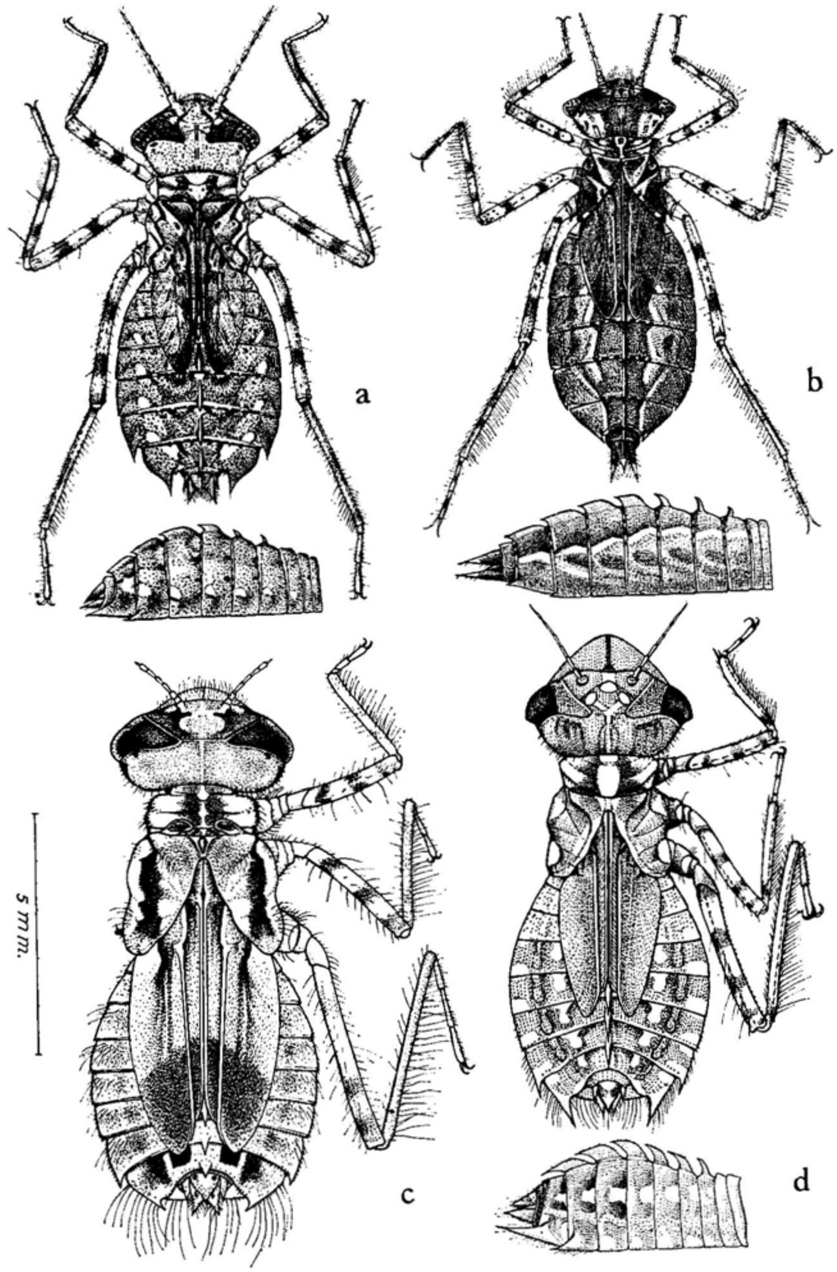


FIGURE 27.—Ultimate instar larvae and right lateral views of abdomen, west Java: **a**, *Zyxomma petiolatum* (live specimen), length 16 mm; **b**, *Tholymis tillarga* (live specimen), length 15 mm; **c**, *Rhyothemis p. phyllis* (live specimen); **d**, *Macrodiplax cora*, length 19 mm.

DISTRIBUTION: Mauritius; Seychelles; Laccadives; India and Ceylon across Indochina to the Ryukyu Is.; through Malaysia to New Guinea and Queensland; Palau.

Only a single specimen (male from Koror) is known from Micronesia.

This is a widespread but easily overlooked species with crepuscular habits. Imagines are seen only toward dusk, appearing on the wing from about one hour before sunset till darkness conceals them. They are observed also during short periods at dawn. They breed in leaf-bottomed ponds, small stagnant pools, cisterns, et cetera, usually in shady surroundings. Imagines are very swift and inconspicuous fliers, but quite common where found. Figure 27, *a* illustrates the full-grown larva (live specimen; imago bred *ab ovo,* in Java). The life history of *Z. petiolatum* will be described in a memoir to be published elsewhere.

Genus **Tholymis** Hagen

Tholymis Hagen, 1867, Stett. Ent. Zeitung **28**: 221 (type: *Libellula tillarga* Fabricius, 1798, Ent. Syst., Suppl., 285; Ind. or.).

39. Tholymis tillarga (Fabricius). (Figure 27, *b.*)

Libellula tillarga Fabricius, 1798, Ent. Syst., Suppl., 285 (type: Ind. or.).

Tholymis tillarga, Ris, 1913, Cat. Coll. Selys, 15, Lib. **7**: 912-915 (Gilbert Is., measurements).—Schmidt, 1938, Ent. Soc. Am., Ann. **31**: 334, 338 (Gilbert, after Ris).—Asahina, 1940, Tenthredo **3** (1): 18, 21 (Saipan, Tinian, Yap, Koror, Truk, Ponape, Kusaie, Wotje).—Schmidt, 1941, Deutsch. Ent. Ges., Mitt. **10**: 26 (Saipan).— Swezey and Williams, 1942, B. P. Bishop Mus., Bull. **172**: 5 (Guam).

Both sexes recognized by cloudy antenodal patch of brown color on disc of hind wing, male moreover by milky-white spot beyond it, quite conspicuous when the insect flies over dark water.

Solitary female collected on Truk exceptionally small, measuring 24.0 mm. for abdomen plus appendages, 31.5 mm. for hind wing.

DISTRIBUTION: Throughout South Asia to Australia and Oceania and westward to tropical Africa and Madagascar. Many, collected on almost all island groups; data not all specified.

N. MARIANA IS. ANATAHAN: Aug. 1951, Bohart.

S. MARIANA IS. SAIPAN: Nov. 1944, Dybas and Edgar. GUAM: May, Dec. 1945, Bohart and Gressitt; Fonte River, Aug. 1945, Wallace.

PALAU. BABELTHUAP: Apr.-May 1949, Langford; Ulimang, about small pool, Dec. 1947, Dybas. ANGAUR: Dec. 1949, Owen.

YAP. YAP: Gagil and Ruul districts, July-Aug. 1950, Goss.

CAROLINE ATOLLS. IFALUK: July 1953, Bates. KAPINGAMARANGI: Ringutoru, Aug. 1954, Niering.

TRUK. WENA (Moen): Female, Civ. Admin. Area, Apr. 1949, Potts.

PONAPE. Ponape: Various loc., July 1949, Owen; June-Sept. 1950, Adams; Jan. 1953, Clarke.

GILBERT IS. Tarawa: Belio, Aug. 1956, Brown.

This common dragonfly is found everywhere in low country, especially along the coast; and, like *Z. petiolatum,* it is decidedly crepuscular in habits. The first individuals appear in late afternoon, hovering low over the water's surface and becoming increasingly more abundant toward dusk. They frequent marshes, weedy tanks, and irrigation ditches, and breed in brackish water.

The larva has a pointed abdomen and a characteristic color pattern (fig. 27, *b,* live specimen from Java, shortly after last ecdysis).

Genus **Pantala** Hagen

Pantala Hagen, 1861, Smithsonian Misc. Coll. **4**: 141 (type: *Libellula flavescens* Fabricius, 1789, Ent. Syst., Suppl., 285; India).

40. Pantala flavescens (Fabricius). (Figures 16; 29, *a.*)

Libellula flavescens Fabricius, 1798, Ent. Syst., Suppl., 285 (type: India).

Pantala flavescens, Rainbow, 1897, Austral. Mus., Mem. **3**: 99 (Gilbert).—Kempny, 1904, Zool.-bot. Ges. Wien, Abh. **54**: 352 (Marshall Is.).—Schnee, 1904, Zool. Jahrb., Syst. **20**: 404 (Jaluit).—Ris, 1913, Cat Coll. Selys, 15, Lib. **7**: 917-920 (Marshall Is.).—Schmidt, 1938, Ent. Soc. Am. Ann. **31**: 334 (Gilbert, after Rainbow).—Asahina, 1940, Tenthredo **3** (1): 19, 21, [Saipan, Tinian, Rota, Yap, Tobi, Ponape, Jaluit (Jabwar), Wotje].—Swezey and Williams, 1942, B. P. Bishop Mus., Bull. **172**: 5 (Guam).—Asahina, 1952, Mushi **23**: 48, 56 (Bonin Is.: Chichi Jima, Haha Jima).

DISTRIBUTION: Tropics and warmer temperate countries of the world; almost cosmopolitan and with strong migratory tendencies. Many Micronesian specimens, collected on almost all island groups; data not all recorded.

BONIN IS. Chichi Jima: July 1951, Bohart.

N. MARIANA IS.

S. MARIANA IS. Saipan: Nov. 1944, Edgar and Dybas. Guam: Jan. 1945, Grether; July 1945, Bohart and Gressitt; Aug. 1945, Wallace.

PALAU. Babelthuap: Apr.-May 1949, Langford. Koror and Angaur: Dybas, Krauss, Langford, Owen.

YAP. Yap: July-Aug. 1950, Goss; Oct.-Dec. 1952, Gressitt and Krauss.

CAROLINE ATOLLS. Ifaluk: July-Aug. 1953, Bates. Pingelap: Jan. 1953, Gressitt. Fais: Oct. 1952, Krauss. Kapingamarangi: Werua I., June-July 1954, including three ultimate larvae, shallow well in taro patch, July 27, 1954, Niering. Lukunor: Nov. 1952, Beardsley.

PONAPE. July 1949, Owen; June-Sept. 1950, Adams; Jan. 1953, Clarke.

KUSAIE. Mutunlik, Feb. 1953, Clarke.

MARSHALL IS. JALUIT: Jabwar I., Apr. 1958, including two ultimate larvae, Gressitt. KWAJALEIN: Jan. 1945, Grether; May 1945, Wallace. ARNO: Ine I., June 1950, La Rivers and Usinger. AILINGLAPALAP: Bikajela, Nov. 1948, Fosberg. EBON: Feb. 1945, Wallace.

GILBERT IS. TARAWA: Aug. 1956, Brown. ONOTOA: July 1951, Moul.

Genus **Rhyothemis** Hagen

Rhyothemis Hagen, 1867, Stett. Ent. Zeitung **28**: 232 (type: *Libellula phyllis* Sulzer, 1776, Abgek. Gesch. Ins., 169, pl. 24, fig. 4; India).

Rhyothemis is found in the tropics of the Old World, chiefly tropical Asia.

KEY TO MICRONESIAN SPECIES OF RHYOTHEMIS

Wing membrane yellowish, base of hind wing marked alternately with opaque brown and golden yellow, at least spots of brown at nodus, and (usually) with apices also tipped with brown .... **41. phyllis vitellina**

Wing membrane subhyaline, hind wing lacking opaque yellow basal spot, but both pairs with irregular dark-brown markings from base to as far as nodus, spots between Rs-Rspl, and isolated or conjoined spots or bands of same color just before or at apices .... **42. regia chalcoptilon**

41. Rhyothemis phyllis vitellina Braeur (fig. 27, *c*).

Rhyothemis vitellina Brauer, 1868, Zool.-bot. Ges. Wien, Abh. **18**: 184-186, 715 (female, male, "Pelewinseln"; type: female, probably lost).

Rhyothemis fluctuans, Semper, 1905, Deutsche Ent. Zeitschr. (Iris) **18**: 246 (Pelew, after Asahina).

Rhyothemis phyllis vitellina, Ris, 1913, Cat. Coll. Selys, 15, Lib. **7**: 938 (key), 941-943, figs. 541-544, pls. 4, 5 (Guam, Palau).—Schmidt, 1938, Ent. Soc. Am., Ann. **31**: 335 (catalog).—Asahina, 1940, Tenthredo **3** (1): 17, 21, pl. 2, figs. 7, 8 (Babelthuap, Koror, Yap).

Rhyothemis phyllis phyllis, Swezey and Williams, 1942, B. P. Bishop Mus., Bull. **172**: 5 (Guam).

Rhyothemis variegata variegata, Swezey and Williams, 1942, B. P. Bishop Mus., Bull. **172**: 5-6 (Guam).

Mouthparts obscured, almost black, in both sexes; clypeus and vertical portion of frons yellowish, frons above darker brown with slight metallic shine in male, distinctly steely blue green in female.

Easily recognized by two large brown spots on base of hind wing separated by opaque yellow coloring; distinguished from other subspecies by smaller size and strongly yellow-tinted wing membrane. Females with polychromatic wing pattern and very variable as to size and extent of dark markings: three isochromatic individuals from Guam colored like male; three others heterochromatic, with obliterated pattern of non-coalescent spots and tips of fore wing hyaline. Palau specimens equally variable. Isochromatic females on Babelthuap, Angaur, Peleliu, and Garakayo; females from Babelthuap include great variety of forms, most heterochromatic individuals being intermediate between two extremes photographed by Asahina; some with apices of wings hyaline, others are black-tipped.

Measurements: Male, abdomen plus appendages 22.0-24.0, hind wing 29.0-32.5 mm.; female, 19.0-20.0 and 28.0-31.0 mm., respectively.

DISTRIBUTION: Guam, Palau, and Yap (endemic).

S. MARIANA IS. GUAM: Male, two females, Jan. 1945, Grether and Wallace; two males, Pt. Oca, May 1945, Bohart and Gressitt.

PALAU. BABELTHUAP: Four males, four females, Ulimang, wooded valley, Dec. 1947, Dybas; three males, south Babelthuap, Apr.-May 1949, Langford; male, two females, Airai, Dec. 1949, Owen. PALAU: Female, Apr. 1936, Ono, "*R. phyllis,*" det. J. G. Needham. KOROR: Male, Nov. 1947, Dybas. ANGAUR: Four females, Dec. 1949, Owen. PELELIU: Male, at light, Aug. 1945, Dybas; female, Jan. 1948, Dybas. NGERGOI (Garakayo): Two males, three females, Aug. 1945, Ducoff and Dybas; two females, Aug. 1945, Hagen.

YAP. YAP: Female, July-Aug. 1950, Goss.

The larva of *R. p. vitellina* is unknown, but we have some full-grown specimens of typical subspecies *phyllis* (Sulzer), from Java (reared *ab ovo,* fig. 27) as well as exuviae of the closely similar *R. triangularis* Kirby from Sumatra.

42. Rhyothemis regia chalcoptilon (Brauer). (Figure 28.)

Celithemis chalcoptilon Brauer, 1867, Zool.-bot. Ges. Wien, Abh. **17**: 25-26 (type: female, Samoa).

Rhyothemis regia chalcoptilon, Ris, 1913, Cat. Coll. Selys, 15, Lib. **7**: 949-953 (part), fig. 550 (wings, type, female), not *chalcoptilon* on pl. 6 (Samoa only).—Fraser, 1927, Insects of Samoa **7**: 40 (Samoa, "not seen," *sic*).—Lieftinck, 1959, Ent. Mitt. Zool. Mus. Hamburg **21**: 46-48, map, fig. 2 and pl. (Samoa, incl. type: syn. and distrib.).

Rhyothemis regia exul, Fraser, 1927, Insects of Samoa **7**: 40 (Samoa).

Rhyothemis regia regia, Asahina, 1940, Tenthredo **3**(1): 17, 21 (Saipan).

Rhyothemis regia, Schmidt, 1941, Deutsch. Ent. Ges., Mitt. **10**: 26, fig. 2 (wing photograph, female, Saipan).

Rhyothemis regia chalcoptilon and subsp., Lieftinck, 1942, Treubia **18**: 516, 518-519, pl. 33, figs. 86, 87 (syn., specific and subspecific characters); 1948, op. cit. **19**: 301-304, fig. 8 (distrib. map); 1953, Seventh Pacific Sci. Congress (Auckland), Proc. **4**: 75-81, figs. 1, 2 (distrib.).

Rhyothemis regia armstrongi Fraser, 1956, Ent. Month. Mag. **92**: 326-328, figs. (male, female, Samoa).

Head mainly dark in both sexes; mouthparts black, frons metallic purple to green, postclypeus with fairly well-defined, dull-orange basal stripe.

Measurements: Male, abdomen plus appendages 24.0, hind wing 32.5 mm.; female, 19.0-20.0 and 28.0-28.5 mm., respectively.

DISTRIBUTION: Marianas (Pagan and Saipan); Samoa Is. and nearby Wallis and Swains Is.

N. MARIANA IS. PAGAN: Two males, female, Pagan, July 1951, Bohart.

S. MARIANA IS. SAIPAN: Male, two females, Garapan, Dec. 1944, Dybas; two males, female, Saipan, July 1951, Bohart.

Both sexes are so strikingly similar to Samoan topotypes of *chalcoptilon*, recently discussed and photographed by me (1959, Ent. Mitt. Zool. Mus. Hamburg **21**), that I am unable to separate them. All are of the same small size and are equally proportioned, and the color pattern of the wings is very nearly identical in the corresponding sexes of each population [see figure 28 and Schmidt's photograph of a female (1941, Deutsch. Ent. Ges., Mitt **10**: fig. 2)]. No examples of the dark-winged (typical) female extreme of *chalcoptilon* are yet known from the Marianas.

R. regia is a polytypic species ranging from the northwestern extremity of Sumatra (Pulu Wé) to Polynesia. It is remarkable chiefly for its peripheral occurrence in the Indo-Pacific, almost exclusively on small islands; few coastal settlements on larger land masses are known (scattered on Celebes and New Guinea). On various islands several well-marked subspecies have become



FIGURE 28.—*Rhyothemis regia chalcoptilon*, male and female, Saipan.

differentiated, but there is some evidence of interbreeding between different populations as a result of reintroduction of colonists, either actively by migration, or passively by air currents. On some islands this makes the characterization of subspecies difficult.

The isolated occurrence of this conspicuous insect on Pagan and Saipan is of great interest. The habitat of *chalcoptilon* on the dry island of Pagan is unknown, but the species seems to have established itself firmly on Saipan, probably breeding in the nearly fresh water of Lake Susupe (Gressitt, 1954, Insects of Micronesia **1**: 50).

Genus **Tramea** Hagen

Tramea Hagen, 1861, Smithsonian Misc. Coll. **4**: 114 (type: *Libellula carolina* Linnaeus and Johansson; Amer. sept.).

This is a widespread circumtropical genus penetrating into the north and south temperate zones of both hemispheres. There are many closely allied species, all showing strong migratory tendencies and breeding in lakes, ponds, and marshes. Adults on emergence wander far from their normal habitat, soaring above jungle and dry plains, often at considerable heights. On reaching maturity they return to the breeding places where pairing and egg-laying is accomplished while in flight over the water, the female during oviposition being attended by the male. The larva is pelagic, living in the midst of aquatic vegetation; body color semitransparent green, marked with brown. Specific differences between full-grown larvae are slight and probably to be found only when long series of each species can be compared (fig. 29, *b*). Two eggs of *T. transmarina euryale* from west Java in different stages of development and the first instar larva following the pronymphal stage (hatched out after eight days) are shown in figure 30, *a, b*.

Key to Micronesian Species of Tramea

1. Genital hamule of male short, not, or only slightly, overlapping lobus posterior, which is globular; upper margin of hamule in side view convex, apex abruptly hooked, tooth small. Genital valve of female shorter than segment 9 of abdomen, lamellae oval, not nearly reaching apex of latter. Frons orange red (male) or yellow (female), dorsal surface with narrow (male) or somewhat broader (female) metallic blue-black basal stripe. Basal spot of hind wing convex but very ragged outwardly, leaving uncolored a broad area along posterior margin of wing but curving away from tornal angle and fitting against anal border for quite some distance (male) or approaching it (female); posteriorly, spot surrounded by amber-colored areola, enclosing subhyaline marginal fenestra beyond membranula. Size relatively small: male abdomen plus appendages 31, hind wing 40 mm.......... **44. loewi**

   Genital hamule of male longer and straighter, projecting beyond apex of lobus posterior. Genital valve of female longer, lamellae lanceolate, reaching apex of segment 9 or overlapping its posterior border. Remaining characters not as above 2

female, Mt. Alutom, July 1945, Wallace.

differences between full-grown larvae are slight and probably to be found only

2. Basal spot of hind wing very large, extending to Ax_3, distal angle of t (or even beyond that level) and involving greater part of anal loop, but in female falling short of anal and posterior borders of wing; color dark reddish or golden brown often surrounded by golden yellow and enclosing large crescent-shaped or triangular fenestra of same color that projects inwardly beyond membranula; costal and subcostal spaces usually likewise golden yellow; base of fore wing often golden amber. Genital hamule of male greatly overlapping lobus posterior. Frons rose red (male) or yellow (female), with very broad purplish-black (male) or blue-black (female) basal stripe. Size large: male abdomen plus appendages 36, hind wing 45 mm.................................**43. virginia**

   Basal spot of hind wing smaller and narrower, placed in transverse axis of wing, and dark reddish brown in color, lacking golden yellow basal fenestra or areolae; basal wing veins red, but membrane almost hyaline and basal cells not amber colored. Genital hamule of male not so strongly protuberant. Frons almost entirely dark metallic violet (male) or orange yellow with thick metallic-blue basal stripe (female). Size moderate: male abdomen plus appendages 34-35, hind wing 41-42 mm..**45. transmarina**

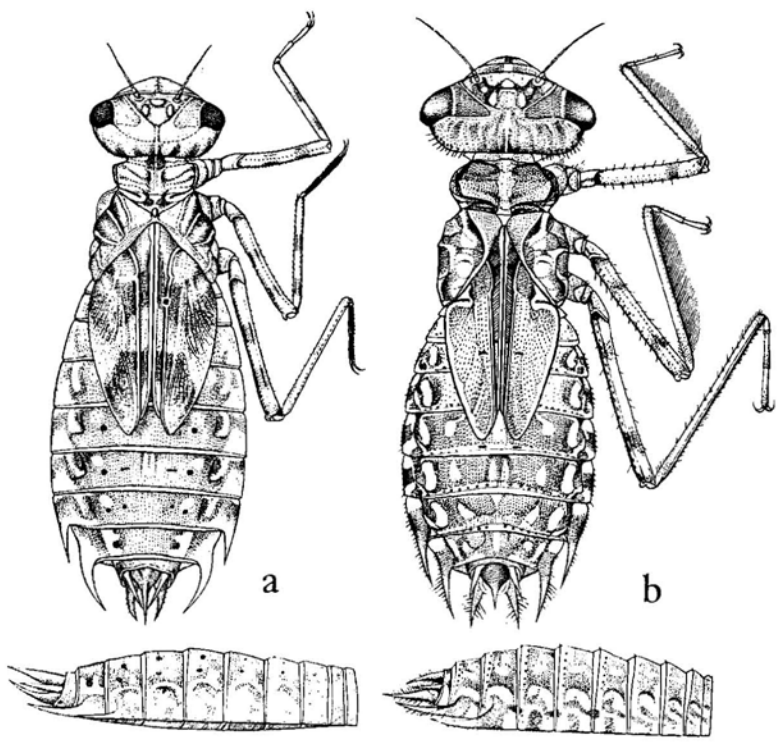


FIGURE 29.—Ultimate instar larvae and right lateral views of abdomen: **a,** *Pantala flavescens,* Sumatra, length 24 mm; **b,** *Tramea transmarina propinqua,* northern New Guinea, length 25 mm.

43. Tramea virginia (Rambur).

Libellula virginia Rambur, 1842, Hist. Nat. Ins., Neuropt., 33-34 [lectotype: male, Amer. sept. (*err.*, rect. China ?)].

Tramea virginia, Ris, 1913, Cat. Coll. Selys, 16, Lib. **8**: 972 (key), 978-979, figs. 566-567.—Asahina, 1952, Mushi **23**: 48 (male, Chichi Jima).

DISTRIBUTION: From Burma and Siam eastward to southern Japan, the Ryukyus, and the Bonins. In southeast Asia, very rare and known only from Billiton and Borneo.

The male from Chichi Jima recorded by Asahina is the only known Micronesian example of *T. virginia.*

44. Tramea loewi Brauer.

Tramea löwii Brauer, 1866, Zool.-bot. Ges. Wien, Abh. **16**: 563-564 (type: male, Ceram).

Tramea loewi, Ris, 1913, Cat. Coll. Selys 16, Lib. **8**: 971 (key), 975-977 part).

Tramea loewi loewi, Lieftinck, 1942, Treubia **18**: 521, 527 (key), 528, pl. 33, fig. 96, pl. 38, fig. 125 (type redescribed and figured; distrib. notes).

Tramea loewi tillyardi Lieftinck, 1942, Treubia **18**: 527 (key), 528-529, pl. 33, fig. 97, pl. 34, fig. 103 (Australia, New Guinea, Kei Is., Tanimbar Is.; n. syn.).

DISTRIBUTION: Throughout Australia and northward into south and west New Guinea, easternmost Lesser Sunda Islands, Moluccas, and Yap.

YAP. YAP: Male, July-Aug. 1950, Goss.

Since discussing southern (mainly Australian) specimens of this insect and treating them as a subspecies of *loewi,* I have been able to examine much additional material from its entire range, including good series from localities not previously recorded (Timor, Aru Islands, northwest Australia, and the north Moluccas). The existence of two geographical subspecies indicated by the material previously studied is not supported by specimens from intervening island groups. Freshly collected examples from north Australia, for instance, are as red as Moluccan *loewi,* the extent and color of the basal wing spots being very similar in males from both regions. Hence the distinction between the two races breaks down so that *tillyardi,* denoting a southern subspecies, should be dropped as a synonym of *loewi.* Outside Australia this is a much scarcer species than *transmarina,* with which it occasionally occurs.

Tramea transmarina Brauer.

Tramea transmarina Brauer, 1867, Zool.-bot. Ges. Wien, Abh. **17**: 293-294 (female, Fiji Is.).—Ris, 1913, Cat. Coll. Selys, 16, Lib. **8**: 979-988 (discussion, full references).—Lieftinck, 1942, Treubia **18**: 520-541, figs. (partial revision); 1949, Treubia **20**: 371-373; 1953, Naturf. Ges. Basel, Verh. **64**: 218-220 (nomenclature).

This is the species currently known in the literature as "*limbata* Desj. forma," or *euryale* Selys. In some previous discussions of Australasian *Tramea* I noted (1942, 1949, and 1953) that Ris' treatise of the Indo-Australian members of this genus in the Selysian monograph was unsatisfactory, the author at that time being well aware of the fact that several species and subspecies were lumped together because of the lack of sufficient material. Since then it has been found that three or four different species whose ranges overlap and which may occur together in one given locality were confused, with the result that the nomenclature as proposed by Ris could no longer be accepted; the tentative grouping of "forms" was likewise untenable. Thus the present species has often been confused with a number of allies inhabiting the same region (*loewi* Brauer, *rosenbergi* Brauer, *eurybia* Selys, and *phaeoneura* Lieftinck), but all are distinct species. A partial revision of the regional species was given by me in 1942, but many questions had to be left unanswered and can only be elucidated in a revision dealing with the Old World species as a whole.

I have been able to examine carefully the Ethiopian *limbata* Desjardins as well as Brauer's syntypes of *transmarina* (*terr. typ.*: Fiji) and *samoensis* (*terr. typ.*: Samoa), and arrive at the conclusion that all "*limbata auct.*" from southeast Asia and the Pacific area are not the true *Libellula limbata* Desjardins (*terr. typ.*: Mauritius), but should bear the oldest available name for the Asiatic group, *transmarina* Brauer. It is still somewhat difficult to assign the proper name to each of the Melanesian subspecies of *transmarina*. Though I agree with Ris that *transmarina* and *samoensis* are very probably the sexes of but one species, the Fijian populations of the former appear curiously mixed, some being almost inseparable from typical *euryale* of Celebes whereas two additional males in the Leiden Museum from Suva, Fiji Islands (March 3, 1949, H. Boschma) have the opaque-colored area at the hind wing base more extensive than Brauer's males, agreeing in this respect with *propinqua* Lieftinck from New Guinea. However, both forms from Fiji are characterized by the presence of a hyaline marginal fenestra posterior to the membranula, which is invariably absent in *euryale* and *propinqua*. As long as a good series of *transmarina* or *samoensis* from Fiji and Samoa is not available for study, it seems best not to apply these names to denote the Indo-Australian subspecies of *transmarina*.

Concerning the Micronesian forms, Asahina (1940) has called attention to the fact that the opaque marking at the hind-wing base is smallest in individuals from the western island arcs, becoming larger and more extensive in eastern populations. The former are identical with *euryale*, the latter with *propinqua*. Since the two sexes of both of these are now well known and have been adequately described and figured, I prefer to use these names, relegating them to subspecific relationship.

45. Tramea transmarina euryale Selys.

Tramea euryale Selys, 1878, Mus. Dresden, Mitt. **3**: 298 (lectotype: female, Manado, north Celebes).

Tramea limbata Desj., Ris, 1913, Cat. Coll. Selys, 16, Lib. **8**: 980, 984-985 (part), 987 (part), form f^4 (Marianas; Guam).—Schmidt, 1938, Ent. Soc. Am., Ann. **31**: 335, 338 (part; cat.); 1941, Deutsch. Ent. Ges., Mitt. **10**: 26 (Saipan).—Asahina, 1940, Tenthredo **3** (1): 19-20 (part), 21, (Saipan, Yap, Babelthuap, Peleliu).—Swezey and Williams, 1942, B. P. Bishop Mus., Bull. **172**: 6 (Guam).

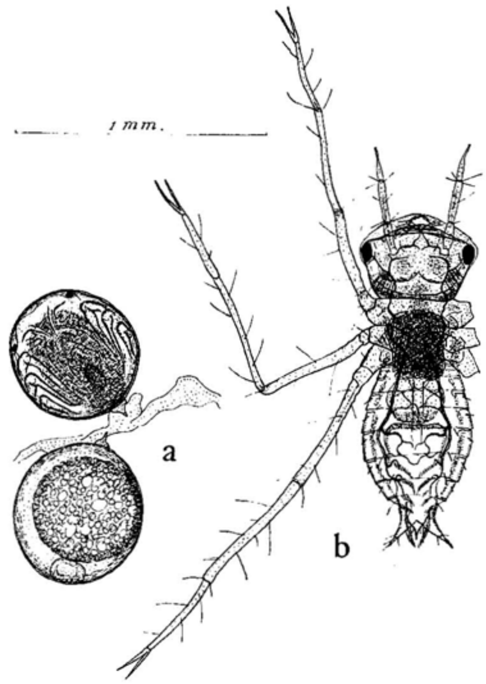


FIGURE 30.—*Tramea transmarina euryale*, west Java: **a**, two eggs in different stages of development; **b**, first instar larva (live specimen).

DISTRIBUTION: Throughout Malaysia and Celebes; Basilan; Mindanao; north and south Moluccas; North and West Micronesia: Palau, Yap, S. Marianas, and the Bonin Is.

BONIN IS. CHICHI JIMA: Female, July 1951, Bohart. HAHA JIMA: Male, Okimura, Apr.-May 1958, Snyder.

S. MARIANA IS. SAIPAN: Five males, three females, Saipan, Nov. 1944, Hagen and Dybas; Aug. 1951, Bohart. GUAM: Two males, Jan. 1945, Grether; female, Mt. Alutom, July 1945, Wallace.

PALAU. Babelthuap: Male, East Ngatpang, 65 m., Dec. 1952, Gressitt. Koror: Female, Jan. 1948, Dybas. Angaur: Two males, female, Aug. 1945, Ducoff; Dec. 1949, Owen. Peleliu: Male, east coast, Aug. 1945, Dybas.

YAP. Yap: Series of both sexes, north and south Yap and Kolonia, July-Aug. 1950, Goss.

46. Tramea transmarina propinqua Lieftinck (fig. 29, *b*).

Tramea propinqua Lieftinck, 1942, Treubia **18**: 521, 524 (key), 539-541, pl. 33, figs. 90, 91, pl. 34, fig. 98 (type: male, north New Guinea); 1949, Nova Guinea, n. ser. **5**: 263 (distrib.).

Tramea limbata Desjardins, Ris, 1913, Cat. Coll. Selys, 16, Lib. **8**: 987 (part), form f^3 (Ponape).—Asahina, 1940, Tenthredo **3**(1): 19-20 (part), 21 (Ponape, Kusaie, Wotje and Ebon, Marshalls).

Tramea sp., Cabot, 1890, Mus. Comp. Zoöl., Mem. **17**: 49 (larva, Ebon; male, Ascension-Panapi, Marshalls).

DISTRIBUTION: From the western extremity of New Guinea, Misool, and the Aru Islands to the Bismarcks and north Australia; east Micronesia: Truk, Ponape, Kusaie, Marshall, and Gilbert Is.

TRUK. Wena (Moen): Female, Oct. 1952, Beardsley. Ton (Tol): Male, Fosson-Chukianu, Apr. 1949, Potts.

PONAPE. One pair, "Ponape, 190," sub *samoensis* Brauer, in Selys' hand (Brussels Mus.); several males, airfield, Colonia and south of Nanpohnmal, and Ngihneni, Aug. 1928, Uchiyama; July 1949, Owen; June-Sept. 1950, Adams; Jan. 1953, Clarke.

KUSAIE. Five males, Mutunlik, Feb.-Mar. 1953, Clarke. Lele I.: Male, July 1949, Owen.

MARSHALL IS. Kwajalein: Two males, Bweje I., Jan. 1941, Wallace, and Gugegwe I., Jan. 1945 Grether. Arno: Male, Ine I., July 1950, La Rivers. Likiep Atoll: Two young larvae, Loto islet, Dec. 1951, Fosberg.

GILBERT IS. Butaritari: Male, June 1944, Enke. Onotoa: Male, Tanyah I., July 1951, Moul.

Genus **Macrodiplax** Brauer

Macrodiplax Brauer, 1868, Zool.-bot. Ges. Wien, Abh. **18**: 366, 737 (type: *Diplax cora* Brauer, 1867, op. cit. **17**: 292-293; female, Ceram).

47. Macrodiplax cora (Brauer). (Figure 27, *d*.)

Diplax cora Brauer, 1867, Zool.-bot. Ges. Wien, Abh. **17**: 20-21 (Ceram; type: female).

Macrodiplax cora, Ris, 1913, Cat. Coll. Selys, 16, Lib. **8**: 1036-1038, fig. 601.—Asahina, 1940, Tenthredo **3**(1): 18, 21 (Saipan).

DISTRIBUTION: Indian Ocean (Socotra, Seychelles, Mascarenes), and from India across southeast Asia to Samoa and the Marquesas Is.

S. MARIANA IS. SAIPAN: Male, two females, Aug. 1951, Bohart.

PALAU. ANGAUR: Two females, Aug. 1945, Dybas; Dec. 1949, Owen.

YAP. YAP: South, male, July-Aug. 1950, Goss.

This species is easily recognized by the large head, the open venation, and the broad black middorsal stripe on the abdomen, which is somewhat contracted in the middle of each segment. The size is variable; extremes from all over the Indo-Australian archipelago show the following measurements: Male, abdomen 25, hind wing 31.5 mm. (Manila), and 30, 37 mm. (Murua I., east Papua); female, abdomen 22.5, hind wing 28.5 mm. (Obi I., Moluccas), and 29, 38 mm. (Murua I., east Papua). Micronesian examples are intermediate as to size.

This is a well-known migratory species, chiefly insular and coastal. It is salt-tolerant, preferring open country and breeding freely in lagoons and estuaries of rivers.